

# HANDBOOK FOR SPACE PROCESSING SOUNDING ROCKET SCIENCE PAYLOADS

N75-17864

Unclas  
G3/46 10234

Report No. M-EH-75-2  
NASA-MSFC  
MARCH 1975



PRICES SUBJECT TO CHANGE



Reproduced by  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
U.S. Department of Commerce  
Springfield, VA. 22151

# HANDBOOK FOR SPACE PROCESSING SOUNDING ROCKET SCIENCE PAYLOADS

## ABSTRACT

The primary objective of the scientific investigators and suppliers of flight apparatus concerned with space processing sounding rocket payloads is to obtain interpretable measurements from their sensors and specimens. To achieve this objective, the investigators must help define mission requirements, experiment development, integration and testing, prelaunch activities, and operations and they must be prepared to analyze the samples and data upon receipt. NASA operational personnel, in turn, must keep prelaunch preparations as brief as possible commensurate with reasonable success probabilities, provide a reasonable balance between system capability and simplicity, and provide flight data as rapidly as possible. Based upon similar flight projects previously conducted, the following guidelines are recommended: (a) The experiment life cycle cannot be allowed to exceed reasonable periods or the overall project will be compromised, (b) simplification of the experiment/science payload interfaces is highly desirable to minimize problem areas, (c) technical and management coordination should be simple and direct, (d) experimenters will need to use good financial management techniques, to keep costs at the lowest possible level so that the rocket project budget can provide recurring flight opportunities, and (e) experimenters will need to meet schedules, provide quality control, and assure sufficient preparation for data reduction after launch.

This handbook is provided to assist NASA and associated experimenters and apparatus suppliers in conducting a beneficial and efficient Space Processing Rocket Experiment Project.

# TABLE OF CONTENTS

	Page
I. INTRODUCTION . . . . .	1
II. OBJECTIVES OF SPACE PROCESSING ROCKET PAYLOAD PROJECT . . . . .	4
A. General . . . . .	4
B. Mission Objectives . . . . .	4
III. BASIS FOR PARTICIPATION . . . . .	5
IV. SUMMARY OF THE PRINCIPAL INVESTIGATOR'S ROLE . . . . .	5
A. Integrity of the Scientific Investigation . . . . .	5
B. Rocket Operations . . . . .	6
C. Development of Prototype and Flight Instruments . . . . .	6
D. Testing and Integration into the Science Payload . . . . .	6
E. Payload Integration and Launch Operations . . . . .	7
F. Data Processing, Analysis, and Publication of Results . . . . .	7
V. RELATIONSHIPS BETWEEN THE PRINCIPAL INVESTIGATORS AND NASA . . . . .	7
A. Office of Applications (OA), NASA Headquarters . . . . .	7
B. Marshall Space Flight Center . . . . .	8
C. Goddard Space Flight Center . . . . .	8
VI. SOUNDING ROCKET . . . . .	10
A. Rocket Trajectory and Processing Period . . . . .	10
B. Black Brant VC Sounding Rocket System . . . . .	13
C. Gross Payload . . . . .	13
D. GSFC Support Hardware . . . . .	13
E. MSFC Science Payload . . . . .	15
F. MSFC Payload Support Hardware . . . . .	15
G. MSFC Science Payload Hardware Development . . . . .	23
H. PI-Supplied Science Payload Hardware . . . . .	28
VII. MANAGEMENT GOALS FOR PROJECT SUCCESS . . . . .	28
APPENDIX — ANNOUNCEMENT OF OPPORTUNITY NO. 74-1 . . . . .	31

PRECEDING PAGE BLANK NOT FILMED

# LIST OF ILLUSTRATIONS

Figure	Title	Page
1.	Space processing evolution . . . . .	3
2.	Space Processing Sounding Rocket typical project functions .	11
3.	Black Brant VC Sounding Rocket flight profile and events/conditions . . . . .	12
4.	Black Brant VC Sounding Rocket typical separation sequence . . . . .	14
5.	Payload versus low-g time for experiments that require the nonspin platform, Black Brant VC with ogive recovery system . . . . .	16
6.	Black Brant VC Sounding Rocket with the Space Processing Payload mounted on the nonspin platform . . . . .	17
7.	Payload versus low-g time for experiments that do not require the nonspin platform, Black Brant VC with ogive recovery system . . . . .	18
8.	Black Brant VC Sounding Rocket with the Space Processing Payload mounted on the aft and forward baseline Science Payload housing tabs . . . . .	19
9.	Measurement Module . . . . .	20
10.	Support Module . . . . .	21
11.	Nonspin platform . . . . .	22
12.	Space Processing Sounding Rocket Program MSFC maximum payload . . . . .	24
13.	Typical gradient heating module schematic . . . . .	25
14.	Research rocket multipurpose furnace schematic . . . . .	26

## LIST OF ILLUSTRATIONS (Concluded)

Figure	Title	Page
15.	Thermal profile envelope for multipurpose furnace . . . . .	27
16.	Conceptual layout for containerless processing Science Payload . . . . .	29

# HANDBOOK FOR SPACE PROCESSING SOUNDING ROCKET SCIENCE PAYLOADS

## I. INTRODUCTION

This is first edition of the Handbook prepared for an evolving Space Processing Rocket Project. Future editions of the Handbook will contain expanded information as it becomes available.

The primary goal of this Handbook is to acquaint experimenters and apparatus suppliers with the current project objectives and approach. Marshall Space Flight Center (MSFC) will supply additional detailed technical information as required by experimenters selected for initial flights.

The Space Processing Sounding Rocket Science Payloads are designed to accomplish specific scientific objectives. Each experiment is carefully selected from proposals submitted by the scientific investigators. Active participation by the scientific investigators is necessary to preserve the integrity of each investigation, to encourage participation by the best qualified scientists, and to make the results available at the earliest practicable time.

The Skylab space materials experiment results promise a harvest of unique materials and commercial products beneficial to man. NASA has recognized a very clear mandate to lead the continuing flight research necessary to bring to fruition the new era in materials signaled by the Skylab experiments as well as other related ground-based and flight research. The Space Processing Sounding Rocket Project has been initiated to capitalize on this new technology which has generated widespread interest of the international scientific community. A broad spectrum of space processing flight experiments will be conducted aboard available and economical research rockets launched and recovered by the Goddard Space Flight Center (GSFC). The project will concentrate on furthering the dramatic improvements in crystalline homogeneity, defect density, and surface perfection which Skylab has shown are possible.

The Apollo-Soyuz flight in 1975 will significantly enlarge the available flight research data and provide further guidance for the Space Processing Sounding Rocket Project. This rocket project will continue until 1980 when an intensified flight research program will begin, using the Space Shuttle/Spacelab's extensive capabilities to make a quantum jump in our Country's materials research knowledge, and will proceed toward direct applications and commercial involvement.

Private sponsorship of experiments in the Sounding Rocket and Shuttle Program is expected to grow as the evidence of profitable applications becomes widely known. It is anticipated that industrial firms will co-sponsor research on certain rocket missions, will conduct continuing advanced research aboard the Space Shuttle, and will eventually manufacture and recover products in facilities launched into space.

The unique and also remarkably improved properties of space-processed material already observed indicate that a new frontier in materials is being explored. The results may be beneficial to the energy conservation program, the electronics industry, the commercial and defense related use of optical materials, the health improvement programs, the pharmaceutical industry, and other areas yet to be defined. The potential impact to our national technology base makes it essential that NASA provide readily accessible space experiment capabilities to U.S. materials science researchers.

Much fundamental knowledge can be obtained prior to the Space Shuttle/Spacelab flights through use of multiple short duration flights on sounding rockets. This knowledge will aid in identifying and resolving problem areas of process control, such as heat flow patterns in convection and diffusion under low gravity conditions, which may lead to numerous improvements in ground-based materials processing. It will provide a basis for setting priorities for experiments to be conducted on early Space Shuttle/Spacelab missions and will accelerate the ability to use space to commercially produce unique materials which cannot be produced on Earth. Rising international activities in the use of space for materials research provide additional evidence of the potential benefits to be obtained by learning how to exploit space for production purposes.

Approximately three flight opportunities per year are planned to support such investigations in a series of rocket flights sponsored by the NASA Space Processing Program in 1975-1980. Two flights are planned for 1975 with rockets capable of providing 3 to 7 min of weightlessness in each flight. This capability may be extended to 10 min or more per flight later in the project when larger rockets are adopted.

Evolution of materials processing in space is shown in Figure 1.

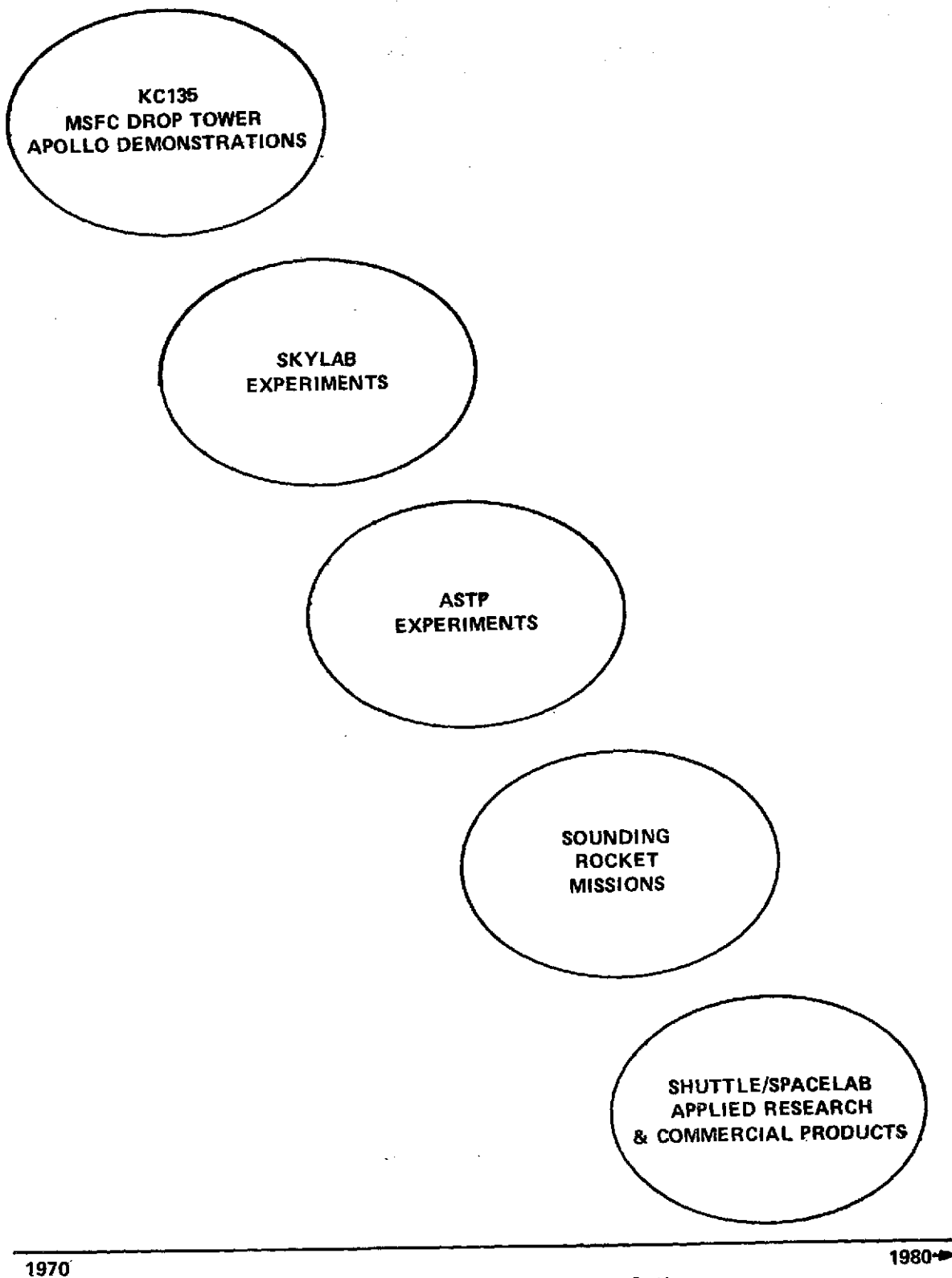


Figure 1. Space processing evolution.



## II. OBJECTIVES OF SPACE PROCESSING ROCKET PAYLOAD PROJECT

### A. General

Within the overall Space Processing Applications Program, the Space Processing Sounding Rocket Project endeavors to: (1) maintain the strong interest in space processing between the 1975 ASTP flight and the Shuttle flights of the 1980's, and (2) cultivate a much broader scientific community involvement by conducting a wide spectrum of experiments. Scientific investigators are encouraged to publish their findings in a variety of publications to create an extensive awareness of the unique benefits of low-g materials processing.

The Space Processing Sounding Rocket Project is an economical and flexible method of providing unprecedented repetitive flight opportunities which will be scoped to the magnitude of user interest. The project will also significantly aid in the development of policies and administrative precedents needed for the planning, effective utilization, and commercial participation in the extensive Shuttle/Spacelab space processing experiment programs.

### B. Mission Objectives

1. The scientific and applications objectives of the missions are:
  - a. To advance the state-of-the-art of space processing using metals, glasses, composites, electronic and biological materials, and other materials of interest. Specific objectives of each experiment will be determined and prescribed by the Principal Investigators.
  - b. To explore promising avenues and investigate questions identified by previous space processing ground-based and flight experiments.
  - c. To evaluate specific processes that offer promise of practical and economic applications.
2. The engineering objectives of the missions are:
  - a. To verify accelerations acting on the payloads during the coast phase of the rocket's ballistic trajectory above 90 km (300 000 ft).
  - b. To evaluate the performance of flight experiment apparatus.

### III. BASIS FOR PARTICIPATION

In general, anyone is eligible to submit proposed flight experiments. All experiment proposals are then screened prior to approval so that the maximum scientific data can be obtained within the resources available to this project. For further details, see the Appendix.

### IV. SUMMARY OF THE PRINCIPAL INVESTIGATOR'S ROLE

Upon selection to participate in a flight, a principal investigator (PI) becomes a member of the project team and assumes the responsibility for preparing the experiment. The PI assists in establishing and conducting the operational program and conducts the processing, analyzing, and publishing of scientific results. In addition, the PI is expected to participate in a number of scientific and technological planning functions. Every effort will be made to avoid diluting the PI role; for example, the NASA past experience with the reliability of specific components and techniques is made available to the experimenters. The project management staff may recommend the use or avoidance of certain parts or practices. However, the final decisions on the internal details of the experiment normally are left to the PI. The primary tests of the suitability of the experiment design is the series of environmental tests to which each Science Payload is subjected before flight. The word of the PI concerning the basis ability of an instrument to make specified measurements will usually be accepted, since it is assumed that he is the best authority on that subject. The ultimate test of the PI is the validity and scientific significance of his findings.

After NASA Headquarters selects the flight experiments, the implementation responsibility is borne by MSFC. The MSFC project manager is then responsible for assuring that appropriate contracts or written agreements are issued to the PI's parent organization. These agreements define the functions of the PI and his responsibilities to the project.

#### A. Integrity of the Scientific Investigation

The PI is responsible for ensuring that his experiment is fundamentally capable of performing the agreed-upon scientific investigation. In carrying out this responsibility, he conducts a research program to determine the detailed

characteristics of the material process and associated instrumentation to minimize the possibility of ambiguous interpretation of the data. This research program also will produce the necessary calibration data for his flight experiment.

## B. Rocket Operations

The primary function of the rocket is to support the experiments. In many cases, the investigators participate in defining mission requirements.

## C. Development of Prototype and Flight Instruments

The PI is usually responsible for developing and constructing the experiment and related instrumentation which is not included as a part of the MSFC Science Payload equipment. The experiment hardware must conform to the various mechanical, thermal, and electrical spacecraft interfaces, under the expected environmental conditions and within the schedule and budgetary limitations agreed upon. These units may be built within the investigator's own laboratories, by contractors whom he manages, or by NASA-directed sources. In any event, the PI has the primary responsibility for ensuring that the experiment operates according to the interface specifications, without interference with other experiments of the same payload, and during the agreed-upon environmental conditions.

## D. Testing and Integration into the Science Payload

Each experiment of the Science Payload is functionally tested as an individual assembly and is environmentally tested after it has been installed into the payload. In both cases, the PI assists in establishing the End Item Specification (EI Spec), Instrumentation, Program and Components List (IP&CL), detailed functional test criteria, and test plan according to the specifications set up by MSFC. He also assists in evaluating the performance of his experiment. For complex experiments, the PI may monitor the tests to determine whether his experiment is performing properly during and after each test.

## E. Payload Integration and Launch Operations

MSFC integrates the experiments into the complete Science Payload and performs environment tests at MSFC prior to shipment to GSFC. GSFC integrates the MSFC Science Payload into the Overall Payload and performs tests. MSFC verifies proper operation during the GSFC tests. Rocket payloads are shipped to the launch site about 10 days before the planned launch. The MSFC Project Manager determines the flight readiness of the Science Payload.

## F. Data Processing, Analysis, and Publication of Results

As a general rule, the experiment samples from the rocket payload can be made available at the launch site within 48 hours after the flight. MSFC will receive from GSFC the processed rocket performance data for each flight. Payload data will be reduced in-house by MSFC and supplied to PIs for experiment correlation.

Postflight evaluation of each mission will be the responsibility of MSFC. Technical teams will be formed to review and analyze the Science Payload engineering data (i.e., dynamics, thermal, systems) within 30 days after each flight. Teams will consist of technical personnel from various disciplines in MSFC's laboratories.

The PI may receive the flight experiment samples at the range within 1 day after recovery and should usually target for submission of a "quick-look" report within 2 weeks after payload recovery and a technical report of significant findings 2 months after recovery. The PI will provide letter progress reports for cases in which more than 2 months are required for completion of sample analyses and associated investigations. Proprietary agreements with the PIs, if required to limit reporting, can be negotiated on a case-by-case basis. A final report for each mission will be issued by the Sounding Rocket Project Manager not more than 90 days after launch and recovery of the payload.

## V. RELATIONSHIPS BETWEEN THE PRINCIPAL INVESTIGATORS AND NASA

### A. Office of Applications (OA), NASA Headquarters

Within OA, overall management of the Space Processing Applications Program has been assigned to the Special Programs Division. For the Space

Processing Sounding Rocket Project, the Special Programs Division will be responsible for establishing overall policy, approving plans, initiating Announcements of Opportunity, obtaining approval of experiment selections and mission assignments, and allocating and expediting the necessary funds to insure successful accomplishment of the project. OA has approval authority for the frequency and the number of missions.

## **B. Marshall Space Flight Center**

MSFC has been assigned two roles by OA in the Space Processing Sounding Rocket Project: (1) overall mission responsibility, including responsibility for success of the project within the cost, schedule, and technical performance requirements, and (2) provision of the Science Payload for each mission. MSFC will identify requirements for rocket flights and negotiate mutually acceptable launch schedules with GSFC. MSFC is the official interface with the principal investigator.

MSFC is responsible for design, development, test and evaluation of the Science Payload. The integration of experiments and experiment apparatus into the Science Payload and the subsequent integrated Science Payload testing will be performed by MSFC. MSFC is responsible for defining the experiment flight requirements which both MSFC and GSFC subsystems must satisfy.

The MSFC and GSFC Project Managers will coordinate project planning, interface requirements, and project changes, through the framework of interface meetings and other means of communication.

## **C. Goddard Space Flight Center**

GSFC, as the NASA Center for Sounding Rockets, has full responsibility for the Sounding Rocket activity on this project. The MSFC mission responsibility does not extend to the technical or management aspects of the GSFC Sounding Rocket activity. GSFC will discharge its responsibility utilizing the documentation, practices, and procedures developed over the 15-year history of the Sounding Rocket Program. GSFC will forward to MSFC, for their information, all documentation that is customarily generated by the Sounding Rocket Division to satisfy its internal reviews. GSFC will also forward to MSFC copies of the annual GSFC Space Processing Sounding Rocket RTOPs submitted to OA. More specifically, GSFC will be responsible for:

- Sounding Rocket system design, procurement, qualification, and operation (excluding the Science Payload).
- Design support for the Science Payload structure.
- Resolution of Launch Vehicle and Rocket Subsystems anomalies.
- Operational safety at GSFC and the launch site.
- Integration of the Science Payload and Rocket Subsystems.
- Science Payload and Rocket Subsystems environmental testing.
- Rocket Subsystems flight readiness.
- Sounding Rocket System flight readiness.
- Range coordination and operation.
- Launch.
- Payload recovery.
- Postflight Sounding Rocket System Analysis (excluding the Science Payload).

Definition of the above terms follows:

Science Payload — Hardware supplied by MSFC which consists of the experiment and Space Processing facilities, e.g., furnaces, experiments, power supplies, and other equipment necessary for the experiment to function.

Rocket Subsystems — Hardware supplied by GSFC consists of the motor-fin assembly, motors, igniter housing with yo-yo design and separation systems, vehicle telemetry (TM) and antennae for both the vehicle and Science Payload TM systems, rocket destruct and location systems, rate control system, Science Payload housings, and recovery systems.

Overall Payload — All subsystems (supplied by MSFC and GSFC) that will be attached to the front end of the motor.

Launch Vehicle — Motor-fin assembly.

Sounding Rocket System — Combined launch vehicle and payload.

Each Science Payload will be assembled and functionally tested by MSFC to qualify it for use under the operating conditions to be encountered during rocket flight. The Science Payload will then be delivered to GSFC for integration with the rocket subsystems. The Science Payload will then be delivered to GSFC for integration with the rocket subsystems. The Overall Payload will then be shipped, normally by air, to the launch site for integration with the launch vehicle and subsequent launch. MSFC and the PIs will conduct a postflight analysis of the Science Payload and experiments, respectively; GSFC will conduct a postflight analysis of the overall Sounding Rocket System, excluding the Science Payload. MSFC, as the PI interface, will provide these analyses to the PIs for correlation with experiment results.

Figure 2 schematically depicts the relationship of a PI and NASA during a typical Sounding Rocket Science Payload flight.

## VI. SOUNDING ROCKET

### A. Rocket Trajectory and Processing Period

The low-g period of the rocket suborbital trajectory will be used to verify low-g effects on processing materials. The low-g period of the rocket occurs above 300 000 ft where air resistance has insignificant effect on the free fall of the flight trajectory.

Preliminary systems engineering analyses have been conducted to assess parameters affecting the stability of low gravity environment during the coast phase of a rocket trajectory above 90 km (300 000 ft). The tentative conclusion reached was that the perturbation of aerodynamics drag, coning, precession, nutation and vibration are not of a magnitude which will adversely influence Space Processing experiments. Additional assessment will be performed on payload hardware items expected to be involved (e.g., furnaces, containerless processing equipment, rate control system, convection measurement package, power supplies, controls, instrumentation packages, etc.) to identify the engineering data to be obtained during the rocket flights. Piggyback flights of certain of these equipment items will be flown as opportunities exist.

Figure 3 shows a Black Brant VC sounding rocket flight profile and events.

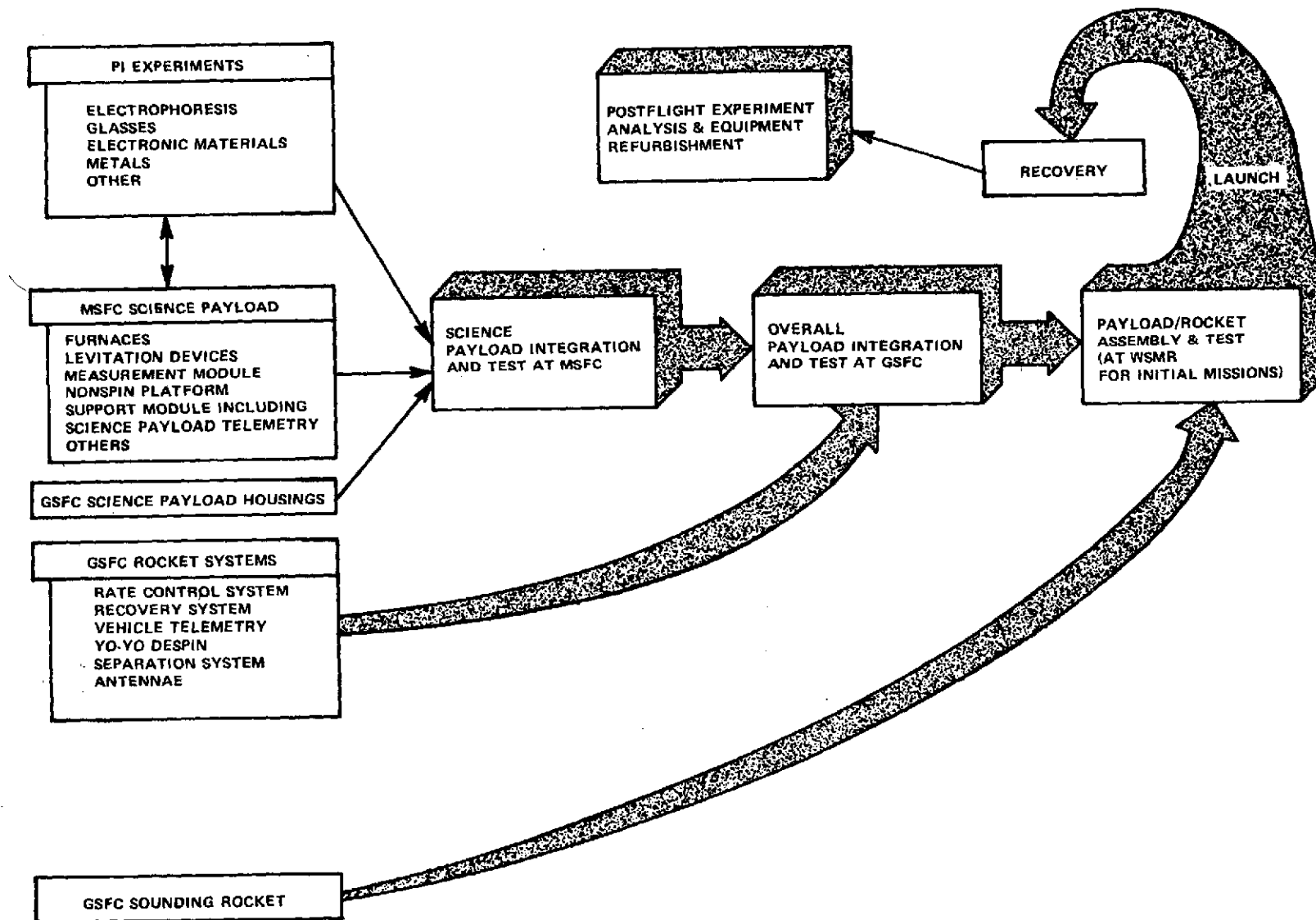


Figure 2. Space Processing Sounding Rocket typical project functions.



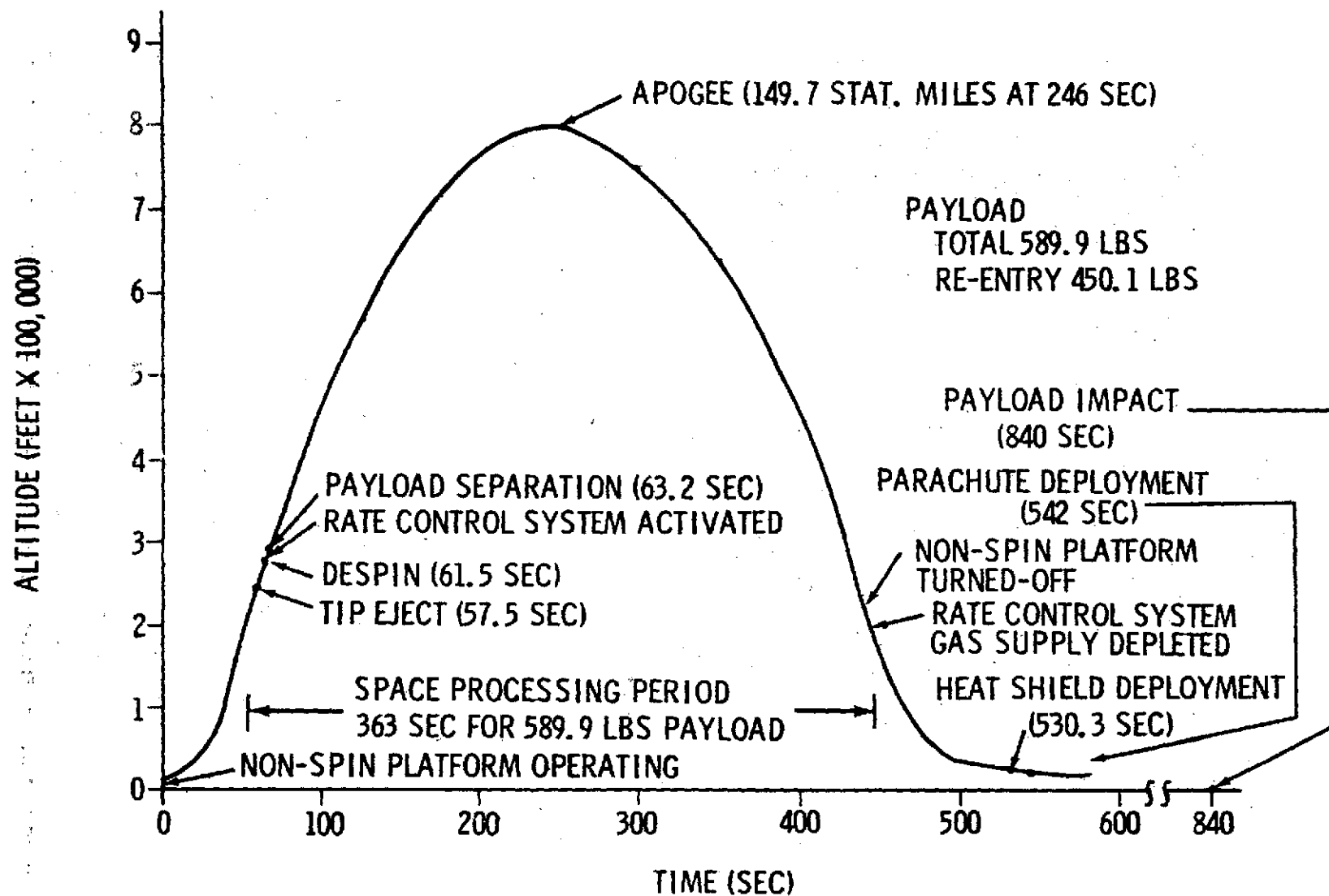


Figure 3. Black Brant VC Sounding Rocket flight profile and events/conditions.

## B. Black Brant VC Sounding Rocket System

The Black Brant VC rocket will be used for the first four flights of the Space Processing Sounding Rocket Project. The Black Brant VC is a solid propellant, fin stabilized, spinning vehicle. Science Payloads will be approximately 100 in. long with an outside diameter of 17.26 in. The allowable payload length is dependent on the payload weight and center-of-gravity location. The peak longitudinal acceleration will vary between 8 and 16 g's depending again on payload weight. The vehicle roll rate varies linearly with velocity from 0 at launch to 4 cps  $\pm$  0.6 rps at motor burnout. The vehicle is despun to 0 cps after atmospheric exit (approximately 76 km). Land recovery is provided for up to 750 lb gross payload.

The Sounding Rocket System to be used after the first four missions will be selected based upon a combination of factors; i.e., number and size of experiments, investigator requirements, optimum frequency of flights, cost effectiveness, and the flight experience achieved up to the date required to select vehicles.

Figure 4 shows separation sequence of the Science Payload from the booster prior to the low-g coast period. Additional information on Black Brant VC rocket flight characteristics are found in paragraph III of Appendix A.

## C. Gross Payload

The gross payload is the total weight separated from the booster after burnout at about 62 sec. The low-g coast period is roughly inverse to the gross payload. For example, a 350 lb gross payload would experience about 450 sec of low-g while an 800 lb gross payload would have about 300 sec of free-fall time.

The gross payload is the total of the GSFC rocket support hardware and the MSFC Science Payload.

## D. GSFC Support Hardware

The GSFC support hardware consists of the nose cone, forward and aft payload housing, vehicle telemetry, reaction control system, payload separation motor and igniter housing.

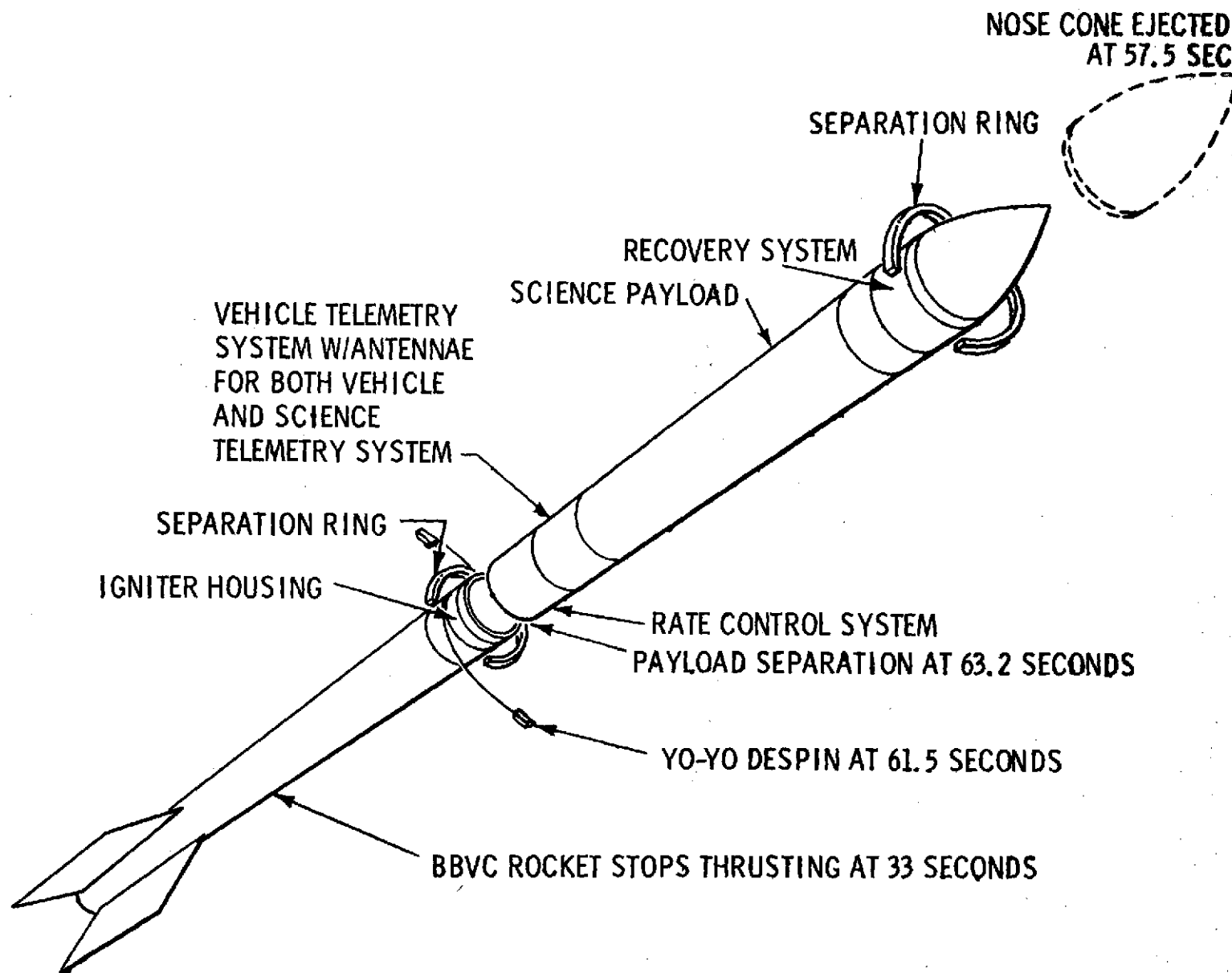


Figure 4. Black Brant VC Sounding Rocket typical separation sequence.

The GSFC support hardware is required on all flights and changes only when ogive nose is used instead of a conical nose cone.

## E. MSFC Science Payload

The net payload is equal to the gross payload less the GSFC support hardware weight. The net payload which is referred to as the MSFC Science Payload weight is divided between payload support hardware and the Science Payload. The payload support hardware used on each flight will be dependent in part upon the particular support requirements needed by Science Payloads sharing a common rocket flight. It is anticipated that the Support Module and the measurement will comprise the payload support on all flights but that the nonspin platform will be included as payload support only on those flights which require that the payload not spin during the boost period.

Figure 5 is a nomograph for estimating the low-g period for total Science Payload when the nonspin platform is flown; Figure 6 shows the rocket and payload support hardware for this configuration. Figures 7 and 8 give the same information for flights that do not require the nonspin platform.

## F. MSFC Payload Support Hardware

The following are the hardware systems that are being developed under the SRT activity by MSFC or GSFC and are considered as candidates for use in the SPSRP. The information presented on each system is for planning only and is subject to revision based on the individual flight experiment requirements.

1. Measurement Module (MM). This module (Fig. 9) contains a highly sensitive system of accelerometers which extends the state-of-the-art in low level accelerometer measurements. The Low-g Accelerometer System (LGAS) is capable of detecting  $1 \times 10^{-5}$  g, as determined by bench tests conducted in April 1974. A prototype accelerometer package was flown as a piggy-back payload in October 1974 to determine the g-levels obtained with the GSFC rate control system. Results confirmed that acceleration levels of 1 to  $4 \times 10^{-4}$  g can be provided for nominal missions. This package will fly on each space processing mission since it is the key to determining the low gravity environment of each flight. Postflight experiment samples will yield comparative acceleration data via material macro- and micro-structure analysis for correlation of events during the flight experiment. The measurement module also contains sensors for measurement of temperature, pressure, acoustics, 3-axis vibration and longitudinal axis shock.

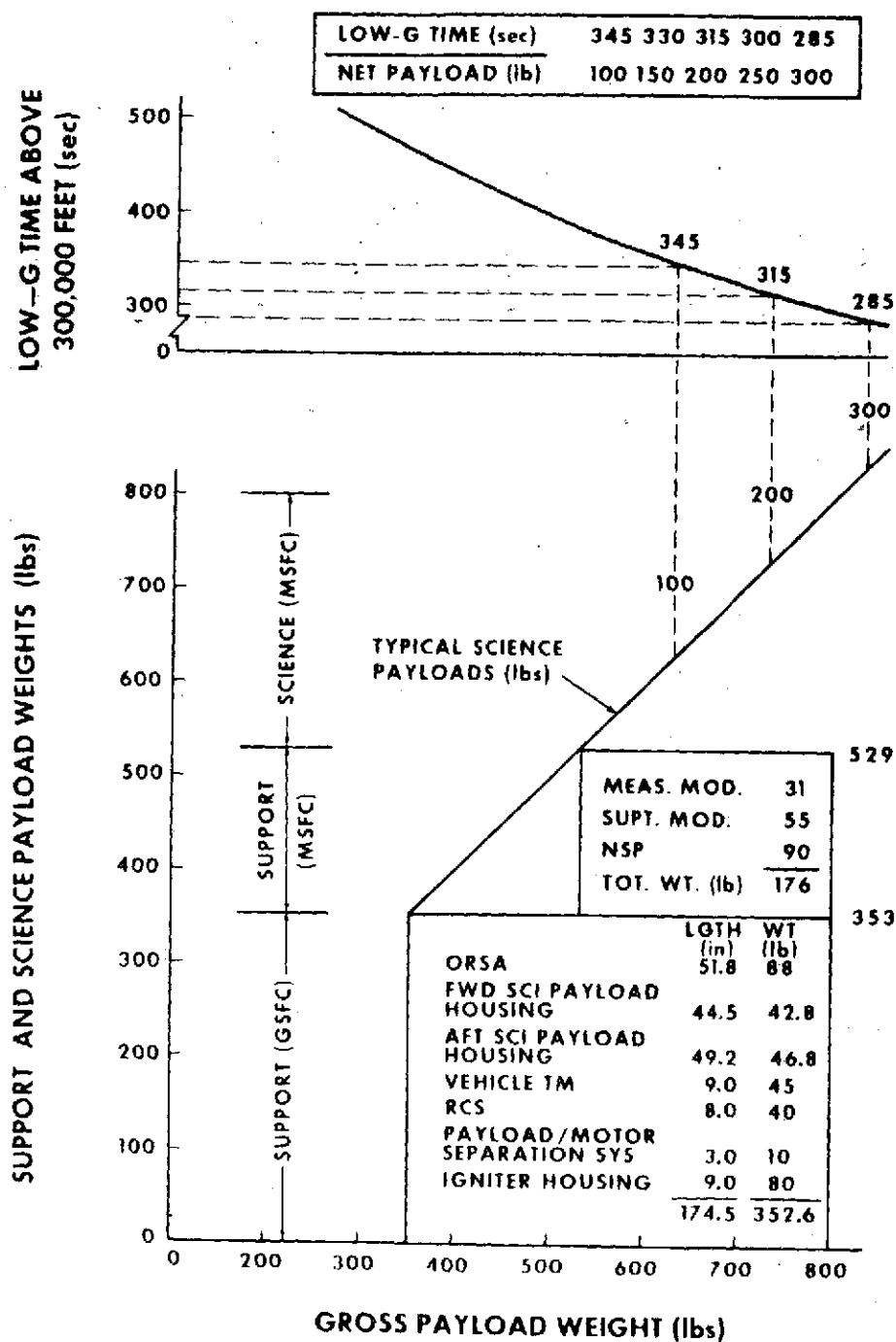


Figure 5. Payload versus low-g time for experiments that require the nonspin platform, Black Brant VC with ogive recovery system.

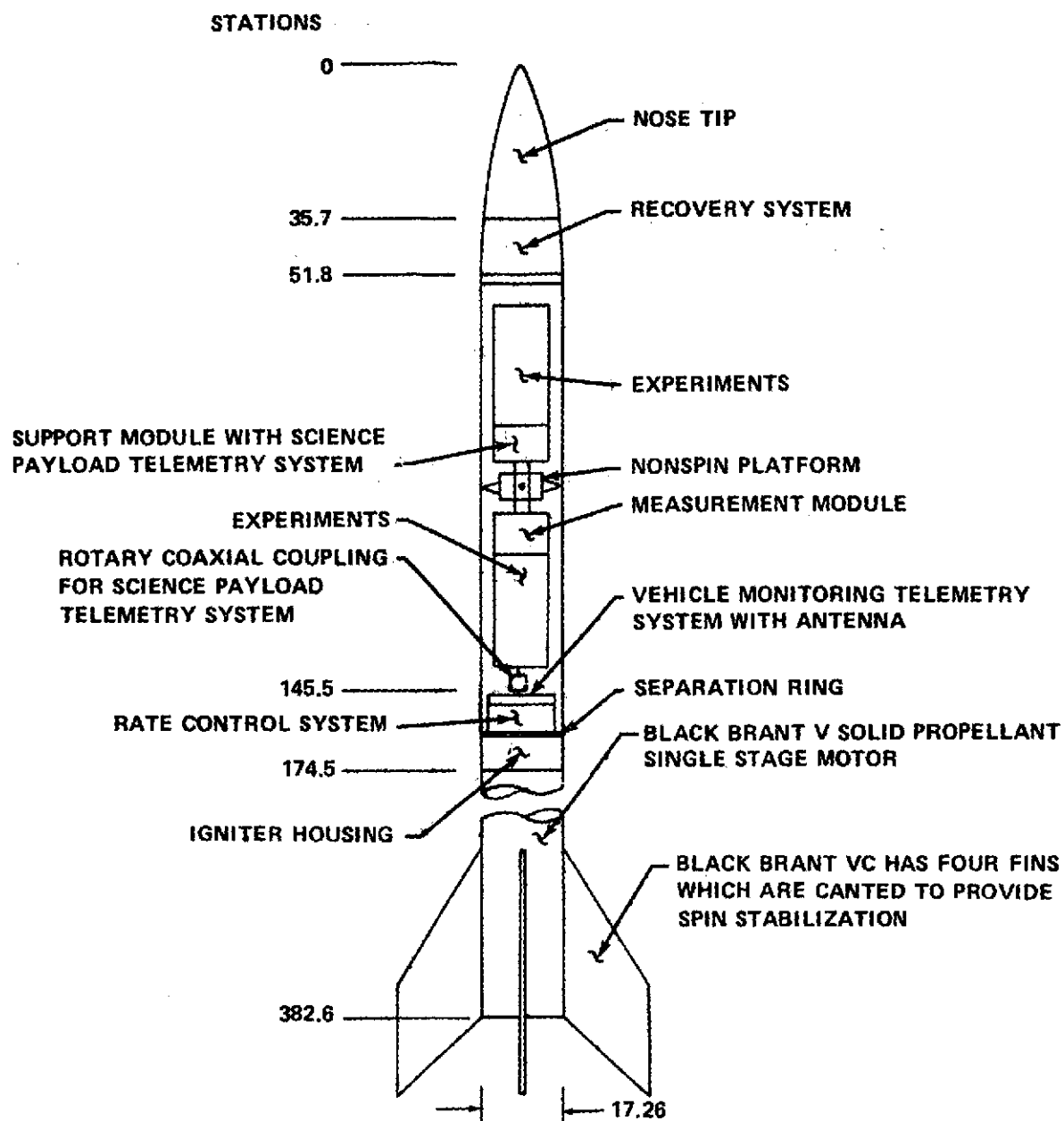


Figure 6. Black Brant VC Sounding Rocket with the Space Processing Payload mounted on the nonspin platform.

2. General Purpose Support Module. This module (Fig. 10) is designed to serve as a common source of Science Payload electrical power, power distribution, and telemetry for a broad range of experiments. It precludes the

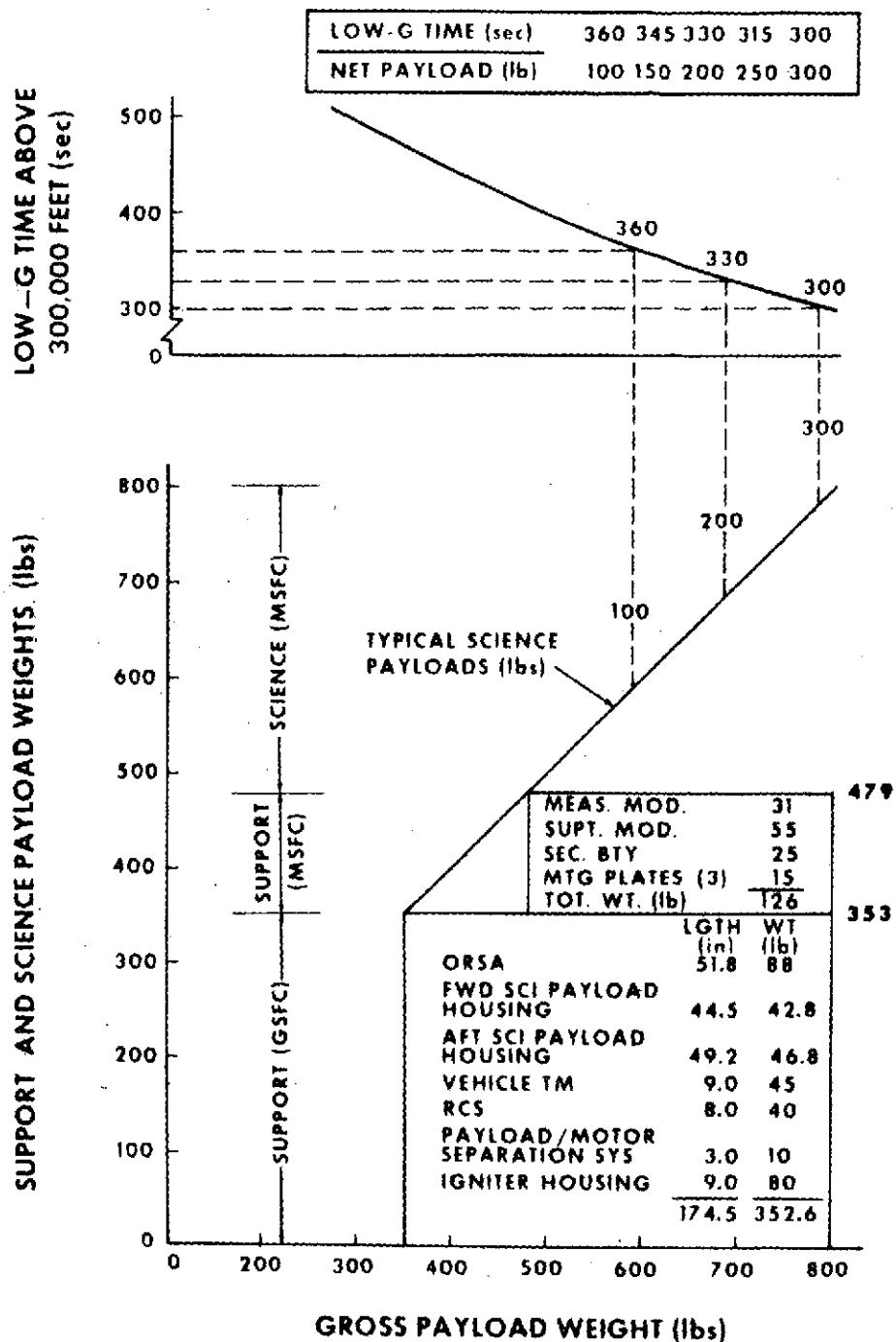


Figure 7. Payload versus low-g time for experiments that do not require the nonspin platform, Black Brant VC with ogive recovery system.

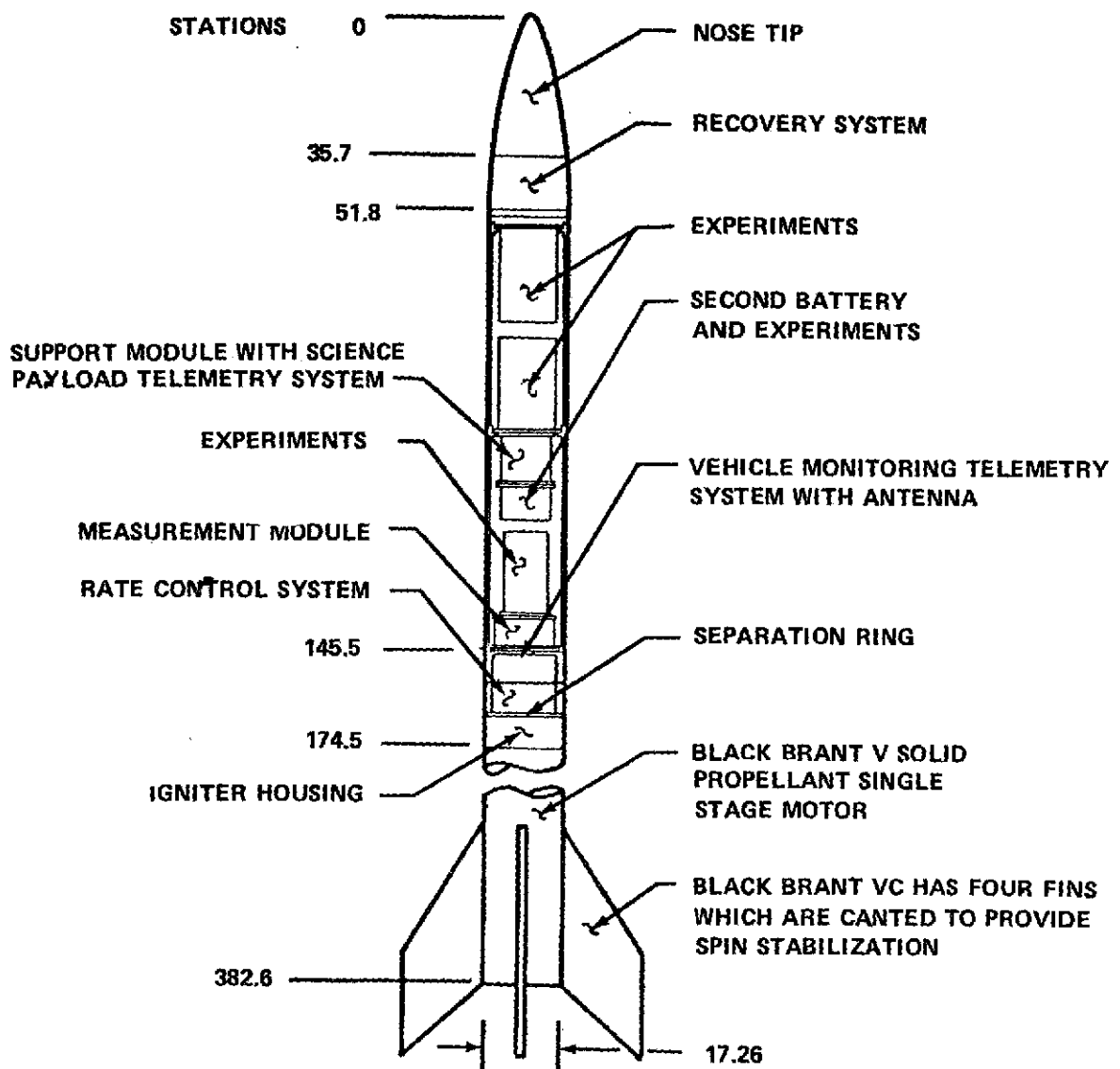


Figure 8. Black Brant VC Sounding Rocket with the Space Processing Payload mounted on the aft and forward baseline Science Payload housing tabs (nonspin platform is not used).

complexities and weight required if each experiment provided its own dedicated source of power and controls. The module presently consists of a structural assembly, 28 Vdc 20 A-hr Science Payload battery, latching relays, an S-band FM-FM telemetry system, g-switches to start experiments, etc., at launch, etc. It has been developed in-house at MSFC and conforms to the equipment design requirements established by the scientific community.



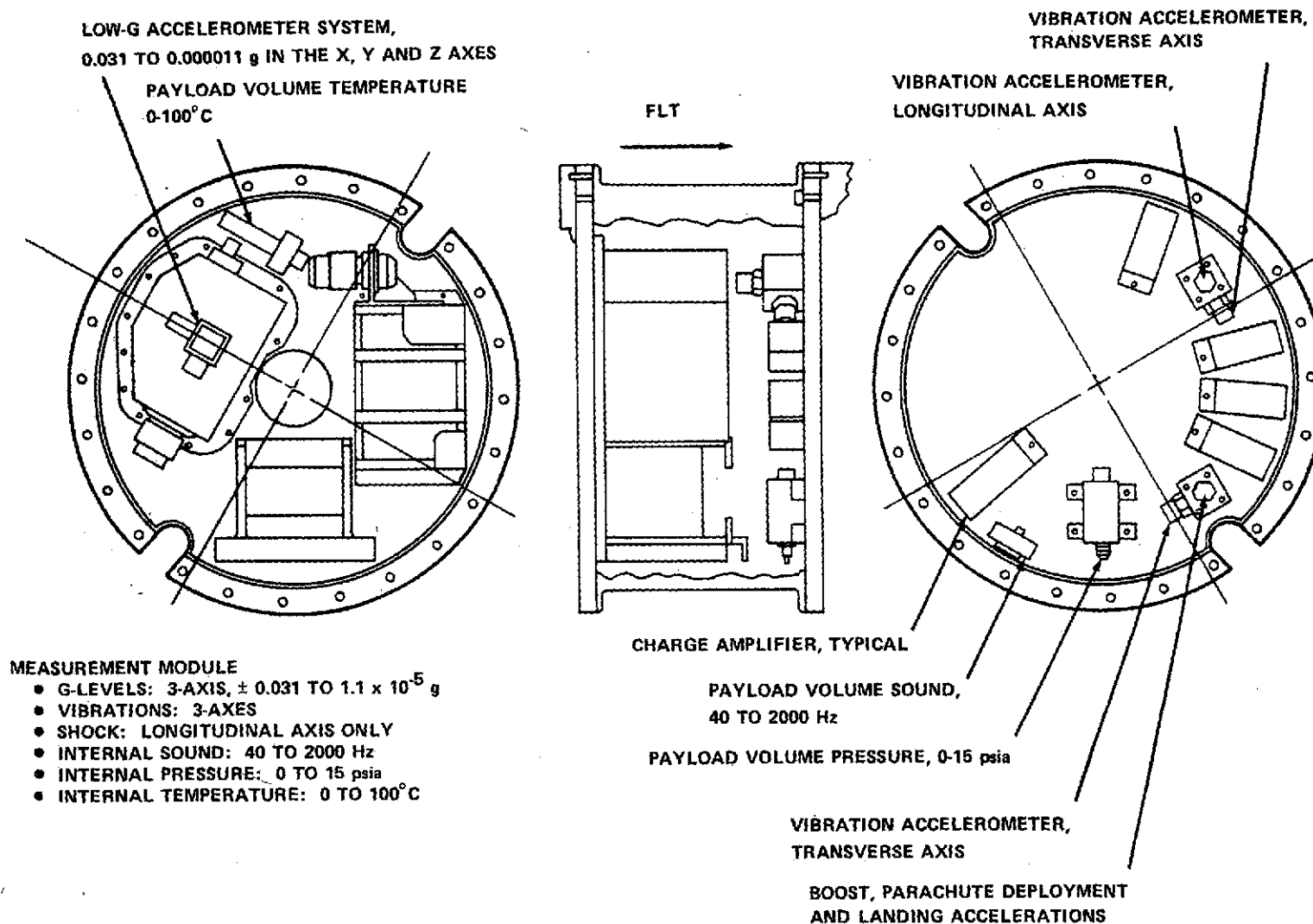


Figure 9. Measurement Module.

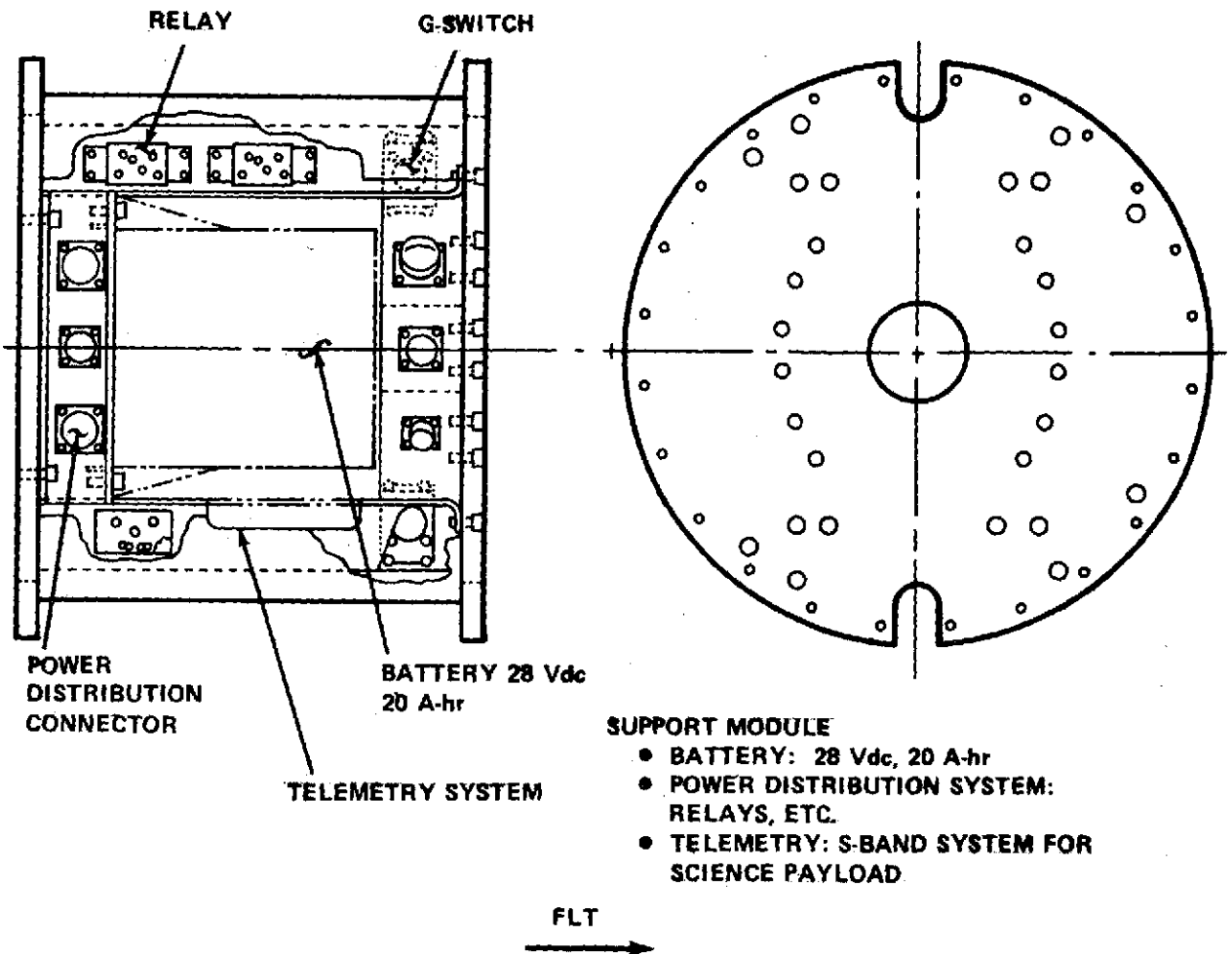


Figure 10. Support Module.

The sounding rocket telemetry system is an S-band FM-FM system with proportional bandwidth SCOs that require the following: input voltage 0 to +5 Vdc, input impedance 5 M $\Omega$  minimum, noise 5 mV RMS maximum.

3. Nonspin Platform System (Fig. 11). The platform system provides mounting surfaces to isolate the experiments from the effects of rocket spinning during the boost phase (0 to 33 sec) and the first part of the coast phase (33 to 60 sec) through despin. The platform consists of a circular metal plate mounted on the ends of a central shaft supported by ball bearings. The platform assembly is attached to mounting pads inside the rocket payload skin section so that the platform is isolated from spinning of the rocket. Sensors are mounted on the platform system to detect rotation and to provide signals for operating an integrally mounted drive motor to maintain the platform system rotation at a nearly zero rate in relation to the Earth.

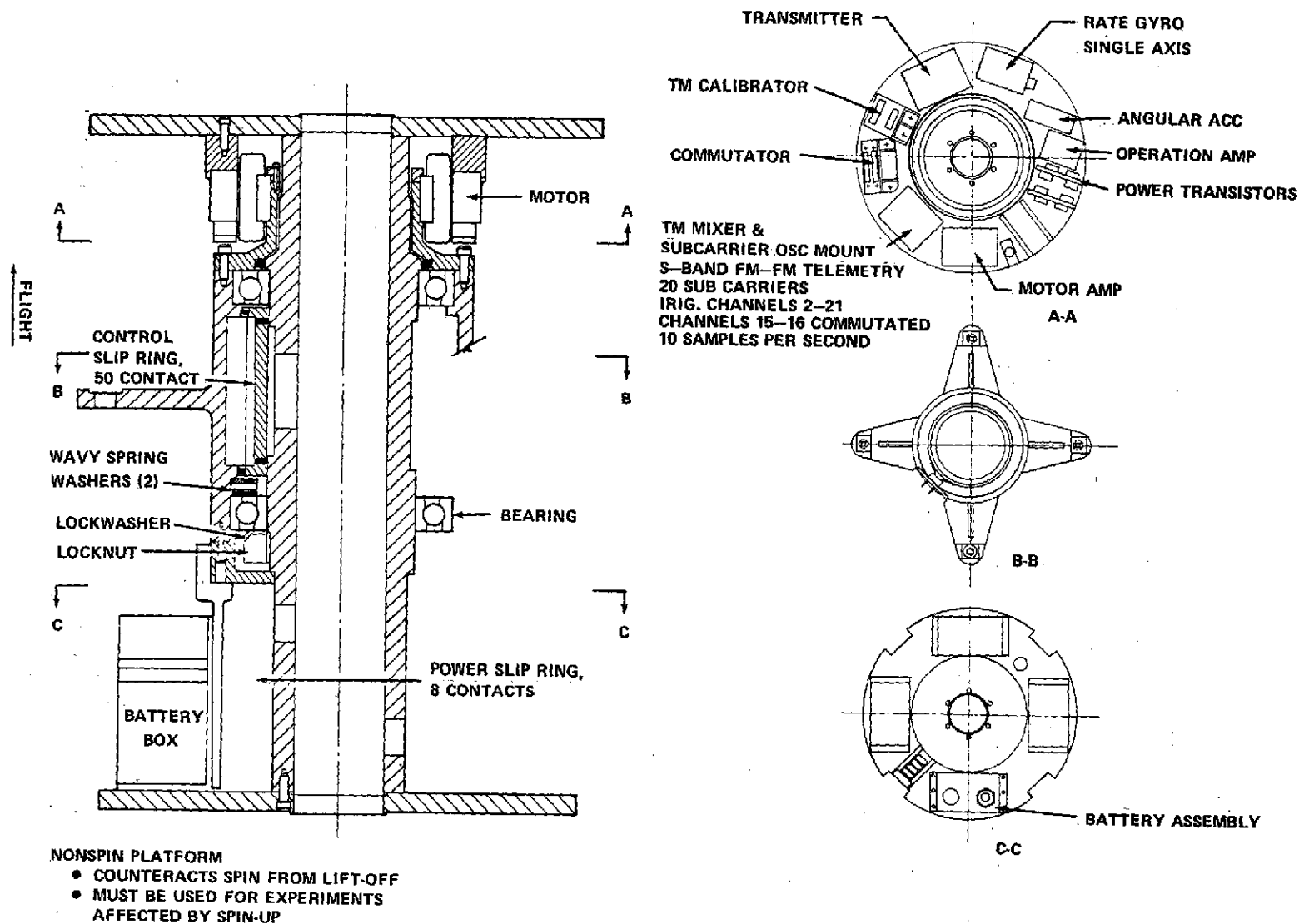


Figure 11. Nonspin platform.

The nonspin platform will be used only for those experiments which cannot withstand the spin-up or despin of the Black Brant VC.

Figure 12 shows where Science Payloads (Space Processing experiments) will be mounted on Payload Support Modules. This figure shows volumes associated with configuration shown in Figure 6.

## G. MSFC Science Payload Hardware Development

Commercial laboratory equipment to heat, position cool, capture and confine materials is not readily adaptable to rocket configuration and environment. MSFC has tried to anticipate the rocket PI needs by engaging in hardware development programs for multiuse equipment to heat, cool and separate confined and containerless materials. Performance of rocket payload hardware will be verified on early flights. The following types of hardware will be available to PIs after flight testing:

1. General Purpose Rocket Furnace (GPRF) — As currently conceived, the furnace (Fig. 13) has a three-zone heating system which can be used for providing isothermal or temperature gradient heating. Cooling may be provided by either water (gradient freeze) or gas (isothermal freeze) as required by the PI's experiment. The GPRF is a follow-on development of the multipurpose furnace used in Skylab and ASTP. It is designed to fit into the Black Brant VC rocket payload compartment. The furnace is designed to reach a temperature of 1150°C, as currently developed. Connections are provided so that ground power may be used prior to launch to raise the temperature to a desired level on the ground. This reduces the in-flight melting time and minimizes the weight and volume of batteries required for experiment operation.

The GPRF may be used for the first mission, if it is compatible with the experiment requirements, because of the relatively short lead time available. Once the equipment requirements are known for the first three missions, MSFC will finalize the flight furnace configuration for each mission.

Figure 14 is the GPRF schematic. Figure 15 shows typical maximum temperature versus processing (low-g) time for a test capsule in the heating/cooling profile. Processing time and temperature will be tailored to PI needs.

Furnace designs incorporating transparent and/or high temperature capabilities are being developed and will be incorporated into flight payloads when development is completed.

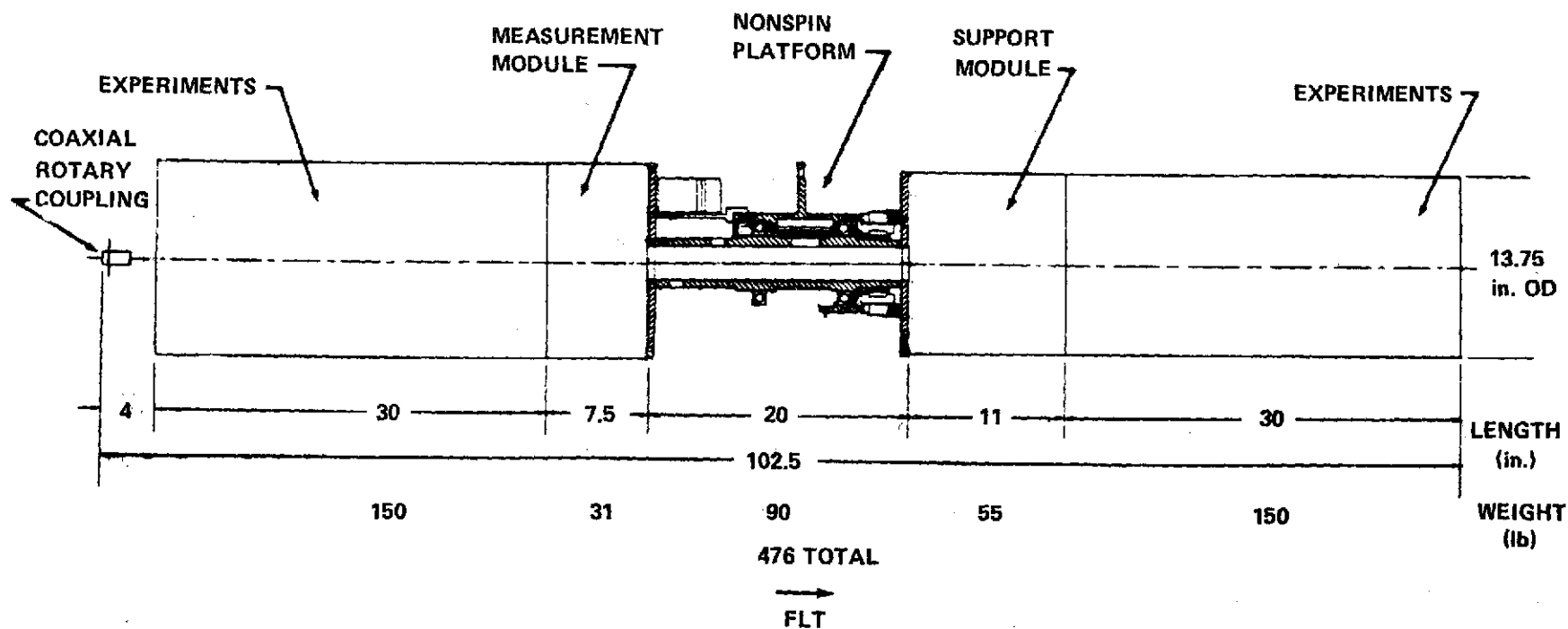


Figure 12. Space Processing Sounding Rocket Program MSFC maximum payload.

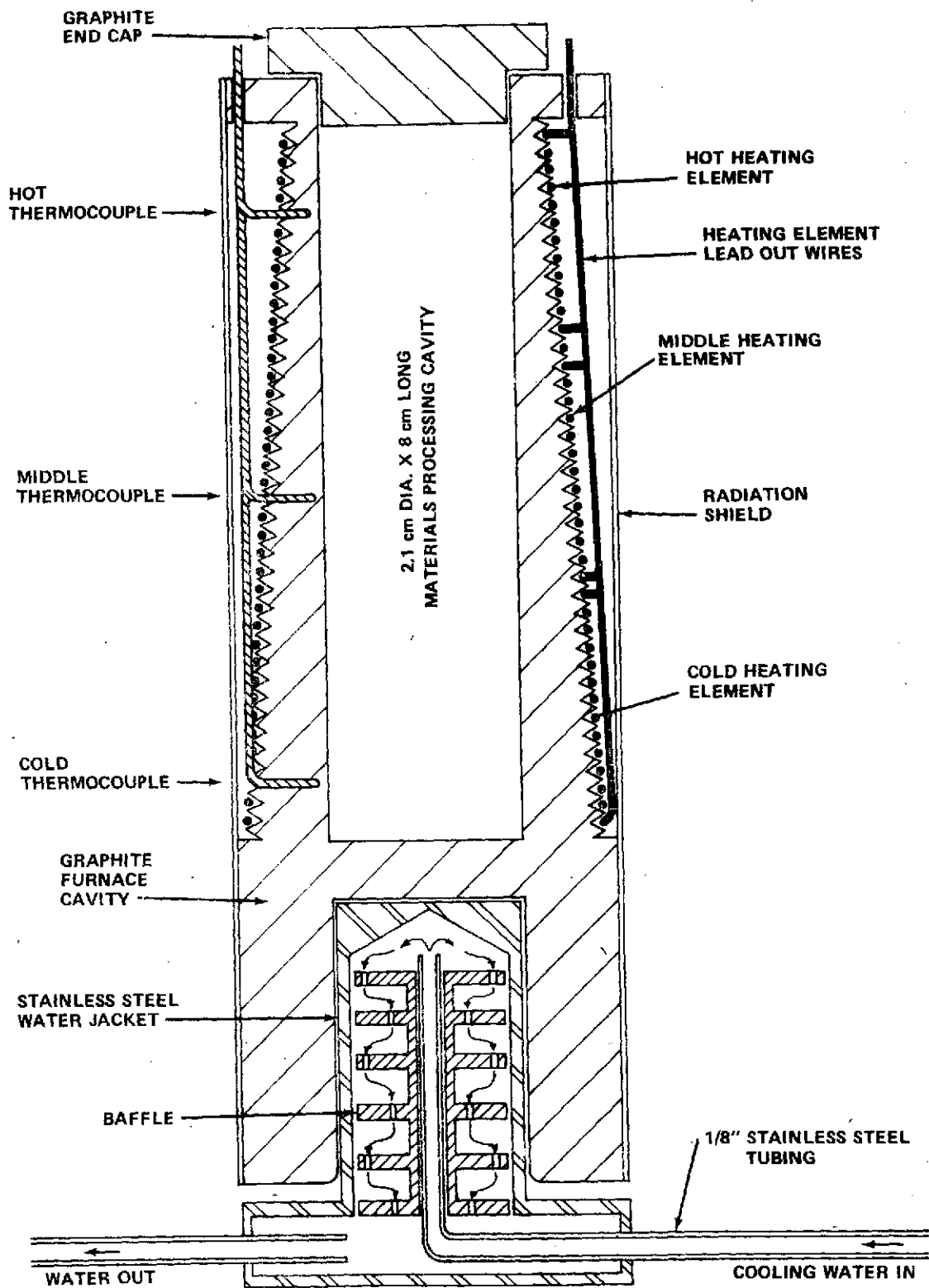


Figure 13. Typical gradient heating module schematic.

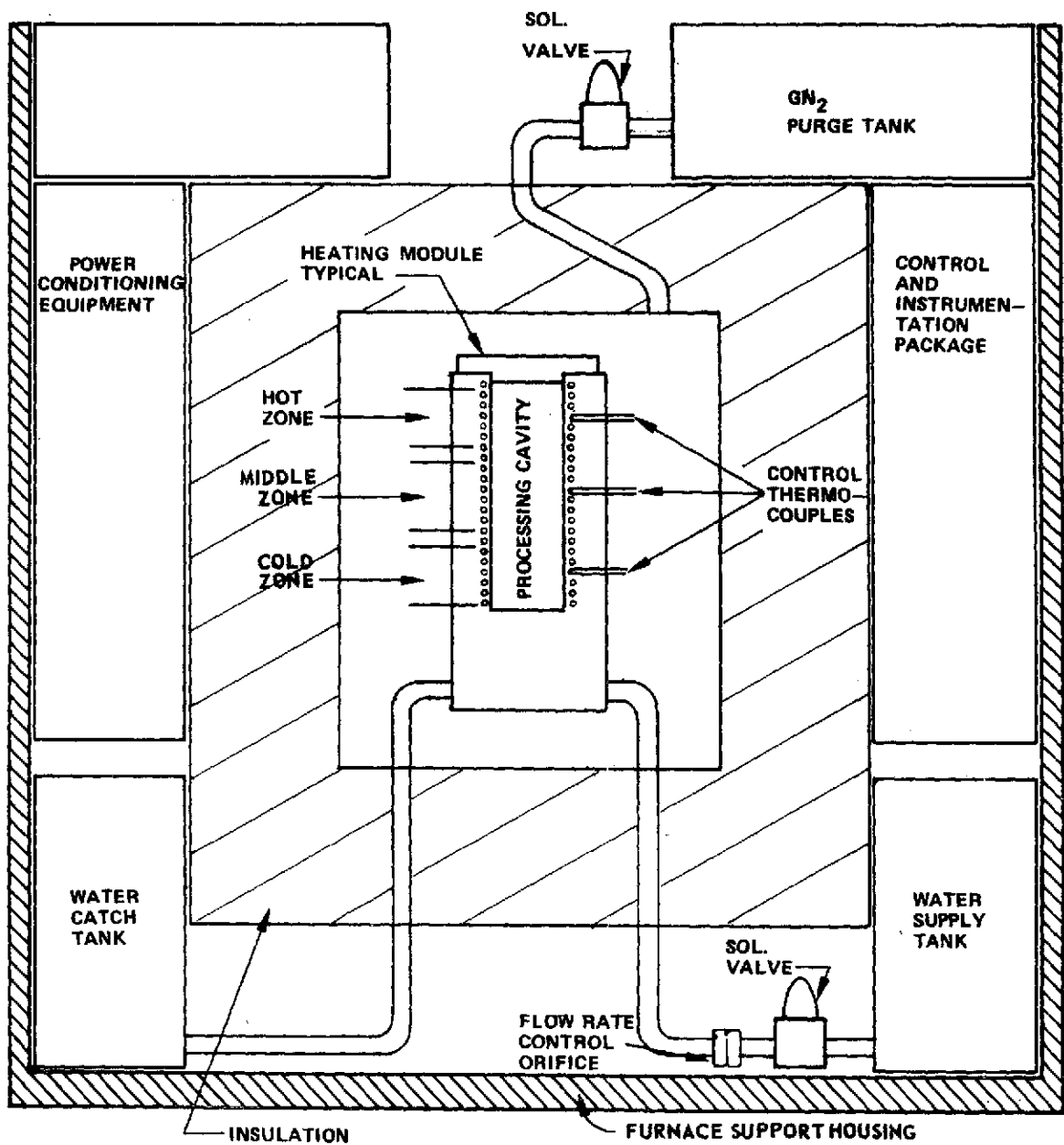


Figure 14. Research rocket multipurpose furnace schematic.

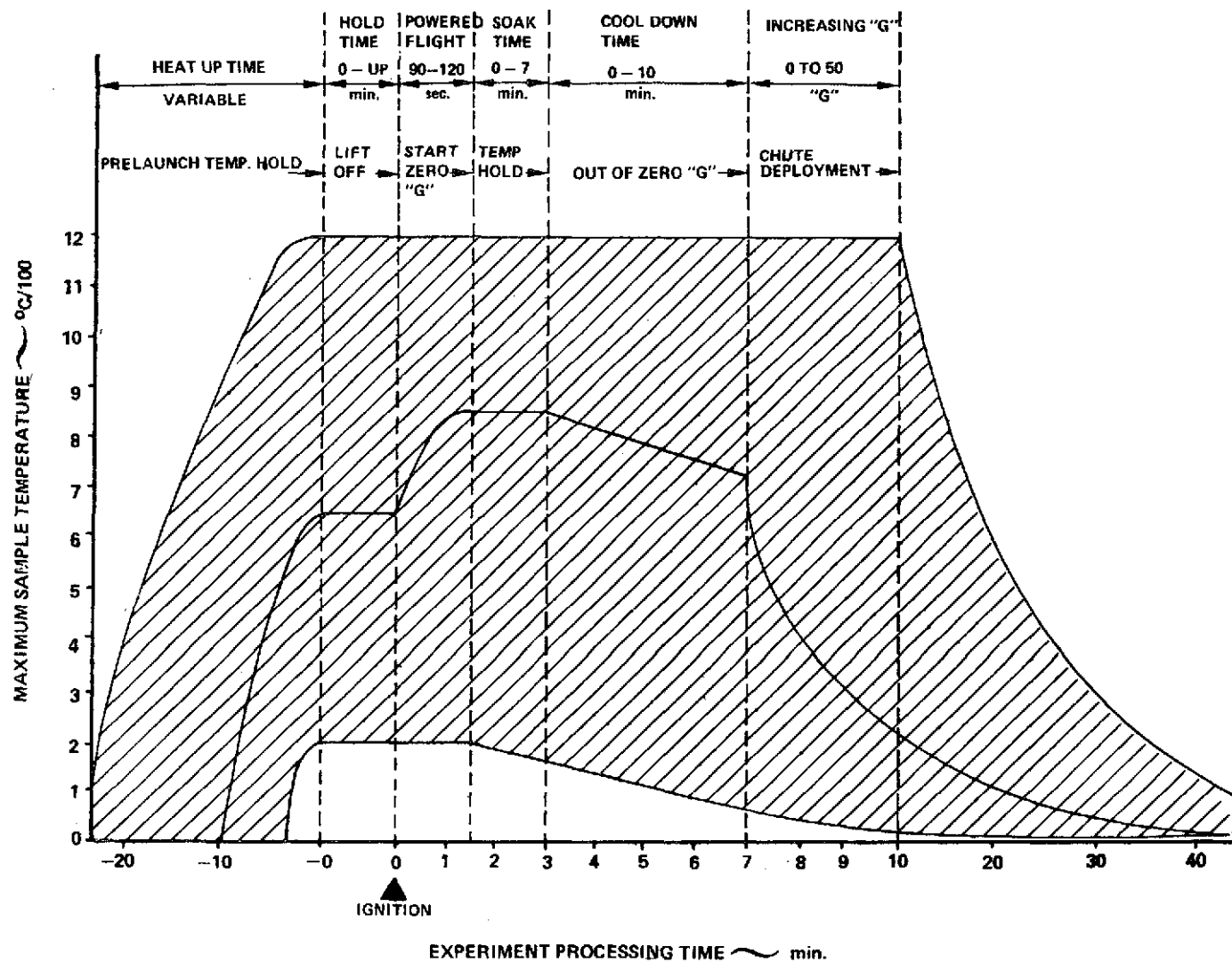


Figure 15. Thermal profile envelope for multipurpose furnace.



2. Electrophoresis Apparatus — Certain types of apparatus for electrophoresis experiments will be developed by NASA and tailored to rocket payloads for use by experimenters.

3. Containerless Processing Equipment — This system (Fig. 16), consisting of either an acoustic or electromagnetic generator, reflector, heater, and controls, can support materials in a container-free position. The heater and controls can be used in an inert atmosphere to melt glass and other experiment materials. It is intended that the system be used to obtain engineering information regarding the problems of sample insertion and control. Development of this equipment was started in 1974. The equipment may be available for use on the third flight, if scientific requirements exist and development progresses well. The flight system will be procured by contract, using the concepts developed under OA SRT studies.

## H. PI-Supplied Science Payload Hardware

Development, testing and integration of PI-supplied hardware is discussed in general terms in Sections IV C and D.

## VII. MANAGEMENT GOALS FOR PROJECT SUCCESS

For three primary reasons — the size of the effort for this project, the requirements for close coordination between the investigators and the MSFC project staffs, and the fact that the activities are always conducted very close to the limits of present technology — a certain amount of pressure and other discomfort can be expected for all personnel. Although this situation cannot be eliminated entirely, there are several areas in which improvements can be made in these working relationships. First, NASA and the experimenter should strive to shorten the experiment life cycle. Efforts should be made to simplify prelaunch activities. Also, flight data should be made available to the experimenter in a timely manner. It also must be remembered that the experimenter's goal is to obtain the greatest possible scientific return with a minimum of effort. Anything that can be done to reduce the experimenter's purely technological development efforts without threatening the integrity of his scientific investigations would be useful. Another area for improvement is to make the technical and management coordination between the experimenters and project staffs as direct and simple as possible. This might be aided to some degree by simplification of the interfaces between the experiment and payload subsystems.

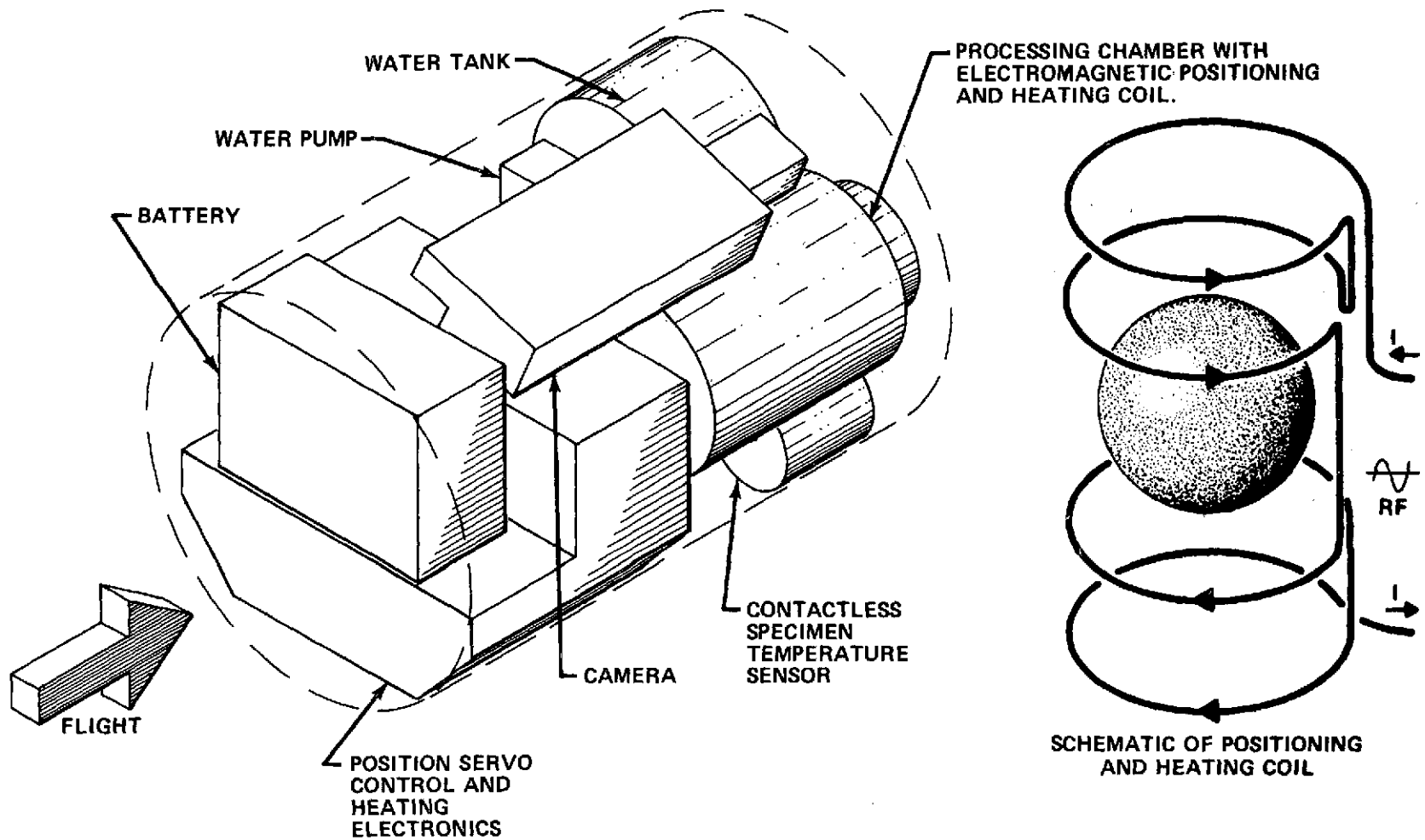


Figure 16. Conceptual layout for containerless processing Science Payload (electromagnetic).

Based upon previous similar NASA projects, there are several areas in which the experimenters could improve their efforts. Many experimenters need to provide better financial management so that the project and experiment costs can be kept under control. This is especially true for data reduction and analysis costs, which have been extremely difficult to predict accurately. The experimenters also need to exercise their abilities to meet payload delivery schedules. Experiment delivery is generally the item that paces the launch schedule for an increasing number of similar missions. Finally, the experimenters need to be prepared to process and analyze their data soon after launch.

Apparatus that is unique to individual experiments will be developed either by the Principal Investigator's organization or by other contractors, as NASA deems appropriate in individual cases. Since the exact definitions of general purpose facilities will not be settled until proposals are received and analyzed, definitions of apparatus unique to individual experiments will be settled by negotiation with investigators whose proposals are selected.

## **APPENDIX**

### **ANNOUNCEMENT OF OPPORTUNITY NO. 74-1**



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546



ANNOUNCEMENT OF OPPORTUNITY

REPLY TO  
ATTN OF:

A. O. No. OA-74-1

November 8, 1974

SPACE PROCESSING ROCKET EXPERIMENT PROJECT

I. Description of Opportunity

This solicitation is an invitation to propose investigations that will make use of the free fall time available during the coasting phases of ballistic sounding rocket flights to perform experiments on the processing of materials under weightless conditions.

Flight opportunities to support such investigations will be provided in a series of rocket flights sponsored by the NASA Space Processing Program in 1975-80. Three flights are planned for 1975 with rockets capable of providing up to 7 minutes of weightlessness in each flight. This capability may be extended to as much as 12 minutes per flight later in the project when larger rockets become operational.

Proposals responding to this solicitation should be for projects planned to arrive at some definite objective through the performance of from 1 to 3 flight experiments. The experiments need not be performed on consecutive flights, but proposed projects should be scheduled so that results will be complete within two years of project initiation.

II. Objectives

The NASA Space Processing Program is intended to develop applications of space flight that will advance materials science and technology: by obtaining research results which contribute to understanding and improvement of processes used on the ground, and by developing means to process products of high value in space for use on Earth. The primary advantage that such applications seek to exploit is the condition of virtual weightlessness obtained in orbital flight, which cannot be duplicated on Earth except in free fall experiments whose maximum practical durations are of the order of seconds.

Opportunities to perform experiments in space are therefore essential for progress in space processing, and the Space-Processing Program has

been active in experimentation on all available manned space flights. Small pilot experiments were carried on three of the last four Apollo missions, and a series of 14 experiments on solidification and crystal growth as well as a group of smaller "science demonstrations" were performed on the Skylab missions in 1973 and 1974. A further set of 10 experiments, including eight on solidification and crystal growth and two on separation of living cells by electrophoresis, is planned for the Apollo-Soyuz Test Project (ASTP) mission scheduled for 1975.

Concurrently with these experiment activities, the Space Processing Program has been planning materials laboratory facilities to be carried repeatedly on flights of the Space Shuttle in the 1980's. These are intended to support continuing space processing research and development work on a scale approximating what is possible in materials laboratories on the ground, and it is expected that the results of this work will significantly affect the future of materials technology.

The recent Skylab experiments have yielded results tending to confirm the belief that space has unique advantages for some kinds of materials research. Moreover, about a third of the experiments produced results not predicted by prior analysis, including some that will require further space experiments to explain. A similar outcome is expected of the experiments on the ASTP mission, some of which will carry on lines of work begun on Skylab. However, the ASTP mission will be the last orbital flight opportunity suitable for space processing experiments until Space Shuttle operations begin in 1980.

The space processing rocket experiment project is being undertaken to continue acquisition of data on processes and development of experimental techniques through the remainder of the 1970's. Although the scope of rocket experimentation will be somewhat limited by the short duration of individual flights, we believe that the rocket project can add substantially to the fund of data on processes in weightless materials because the critical phases of many processes can be carried out quite rapidly. A regular series of rocket launches will also enable investigators to perform repeated experiments with progressive modifications, a new capability which was not possible on the manned missions of the 1970's.

It is considered essential to continue space processing experimentation during the period when facilities for the Space Shuttle are being developed, in order to support the development with the most detailed and extensive information obtainable on processes and techniques. We expect that such information will be derived from consultation with investigators participating in the rocket project as well as from the direct experimental results. In addition it is hoped that the experience gained by members of the scientific and technical community in the rocket project will make it possible to initiate an aggressive materials research and development effort early in the Shuttle flight program.

### III. Specific Requirements and Constraints

#### 1. Characteristics of Sounding Rocket Flights

Flight operations in the space processing rocket experiment project will be conducted initially with Black Brant VC vehicles, which are 17 in. (43 cm) in diameter and use a single stage solid fueled rocket motor. The first flights will be at the White Sands Missile Range with land recovery, but later in the project a shift of operations to Wallops Space Flight Center and water recovery is contemplated.

The typical sequence of events in a Black Brant VC flight is as follows:

a. Launch Phase: After ignition the rocket motor delivers approximately constant thrust for 32 sec., producing accelerations of up to 16g along the thrust axis. During the part of the flight where aerodynamic forces are appreciable, the vehicle is stabilized by external fins set so that it spins about its longitudinal axis and reaches a maximum rate of about 250 rpm. Lateral accelerations also occur due to aerodynamic forces; these can be up to  $\pm 5g$  and oscillate with the vehicle spin frequency of 0 to 4 Hz. Higher frequency vibrations produced by the motor are experienced as well during powered flight.

b. Coasting Flight: Approximately one minute after ignition the vehicle reaches altitudes above 250,000 ft. (76 km) where aerodynamic forces are no longer important. At this point the spin rate is reduced to less than 8 rpm by deployment of a "yo-yo" weight system, and the payload section is separated from the rocket motor. On space processing experiment flights, vehicle rotation rates will be further reduced after separation to no more than 0.2 degree/sec. in all rotational degrees of freedom by a system of gas jets. At these rotation rates, centripetal accelerations will be less than  $10^{-5} g$  at all points in the payload; stabilization to this level will be completed within 75 to 80 sec. after ignition.

Following stabilization, several minutes of weightlessness will be available for data gathering. The exact duration of this period depends on the weight of the payload and the total impulse realized from the motor; an approximate curve of expected performance is given in Figure 1. During this phase of its flight the payload follows a ballistic trajectory and is essentially in free fall.

c. Reentry and Recovery: The payload will typically begin its reentry into the atmosphere between 5 and 8 minutes after liftoff. Aerodynamic forces generally cause tumbling of the payload as well as linear deceleration, and the composite acceleration can reach  $\pm 25g$  along any axis and vary at frequencies up to 2.5 Hz. A drogue parachute is deployed at 20,000 ft. altitude, followed after 12 sec. by the main parachute, and each event can produce shock loads up to 5 g

in any direction. The payload ordinarily lands about 15 min. after liftoff at velocities between 30 and 40 ft/sec., and is usually returned to the launch site by helicopter.

If costs and operational factors are favorable, the space processing experiment project may change over from the Black Brant VC to the Aries rocket after a year or two of operation. The Aries system uses a 44 in. (110 cm) Minuteman second stage motor, which delivers about 4.4 times as much total impulse as the Black Brant motor. In addition to larger payload capacity, the Aries vehicle has active heading control during the launch phase and therefore is not given an axial spin. However, payloads for Aries flights will have to be designed for about the same acceleration, shock and vibration levels as for Black Brant VC flights.

## 2. Factors Affecting Experiment Design

a. Cost and Complexity: The sounding rocket experiment project is primarily intended to develop experimental techniques and accumulate operational experience in preparation for the Shuttle/Spacelab flight program, which will provide capabilities for much more ambitious experiments. By far the most important problem affecting plans for Shuttle payloads is that of performing experiments at much lower costs than has been possible in previous flight programs, since large numbers of experiments will be possible only if their costs are low. The rocket project will specifically seek to develop means of doing space processing experiments cheaply.

It is believed that the largest savings can be made in costs of equipment development, since the costs of flight operations and support for investigators are more or less fixed for any given level of flight activity. The rocket project will seek to minimize equipment costs by imposing minimal qualification and documentation requirements, by developing equipment that can be used repeatedly by multiple investigators, and by starting its operations with relatively simple equipment that can be upgraded as new experiment requirements evolve.

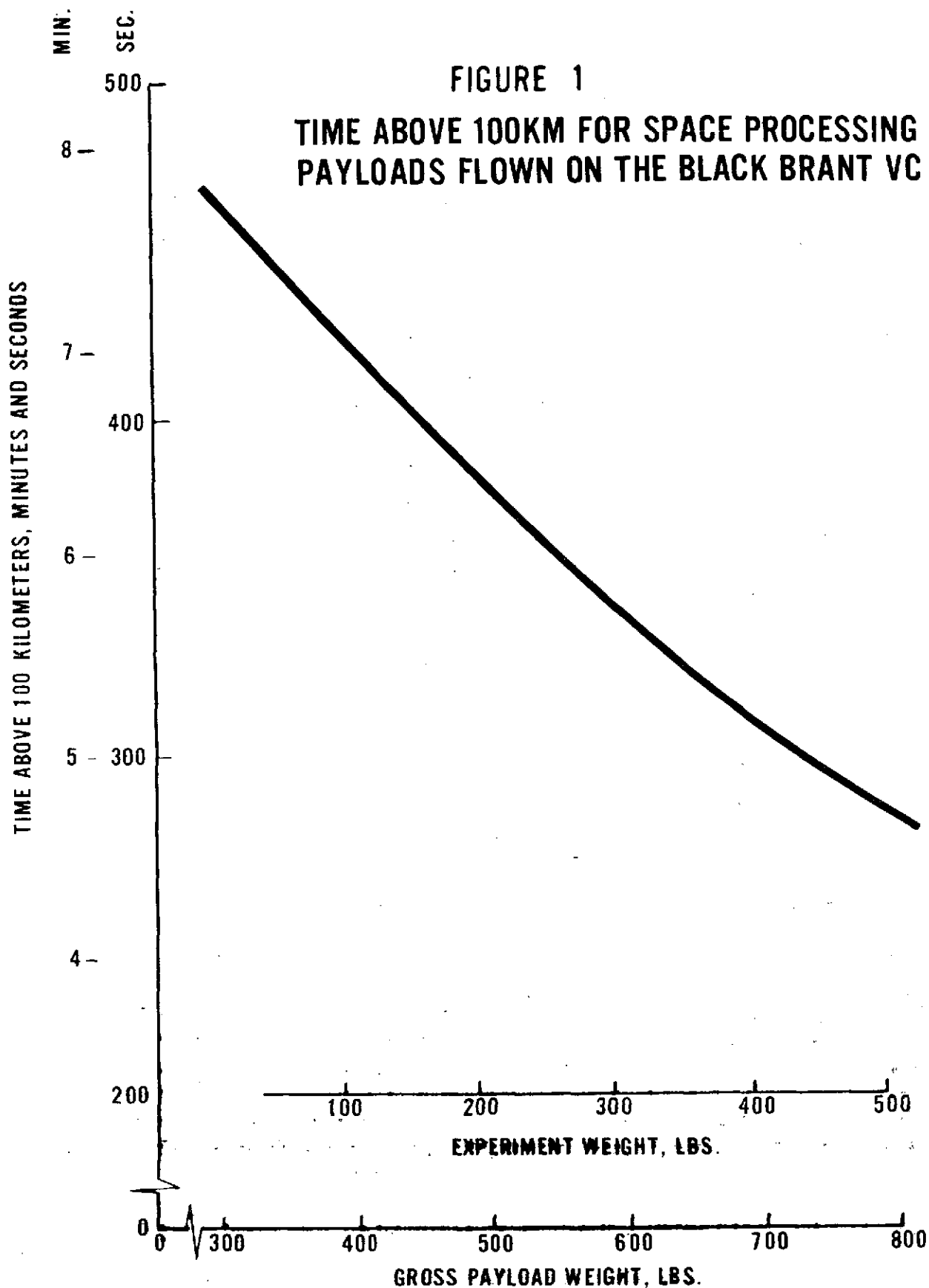
In accordance with this approach, proposals responding to the present solicitation should generally envision simple experiments that will provide a basis for evolutionary development as the program progresses. Since the rocket program is planned to continue for six years, the most desirable types of experiments for the first two years will be ones that show how significant scientific and technical accomplishments can be achieved in the ensuing four years.

b. Constraints Due to Flight Characteristics: It will be necessary to secure both payload apparatus and sample materials during launch and recovery on rocket flights because of the large, diversely oriented accelerations experienced in these flight phases. A rotating payload mounting platform is currently being developed by the Marshall Space Flight Center (MSFC) to eliminate the effects of axial spin during Black Brant VC launches. However, axial spin is the only one of several sources of acceleration that can be neutralized during powered flight.



FIGURE 1

TIME ABOVE 100KM FOR SPACE PROCESSING  
PAYLOADS FLOWN ON THE BLACK BRANT VC



Consequently, experiments that require quiescent fluid samples in the weightless flight phase will need to include means for rapid damping of internal motions in such samples if they are to be launched in the fluid state. In addition, experiments requiring return of processed samples will have to make provisions to secure the samples safely in the final seconds of coasting flight before aerodynamic reentry forces become large. In particular, samples from heat treating experiments must be cooled to temperatures at which they can be secured without damage before reentry, and liquids must be confined so that they cannot damage the payload apparatus.

c. Vehicle Resources: In addition to the equipment mentioned above which is designed to limit accelerations, NASA plans to provide the following general supporting resources for initial payloads:

1. Electric power will be provided by 28 volt DC batteries in flight. At present a battery with a peak load current of 100 amp. (2.8 kw) is planned. Before liftoff, payload power will be supplied by umbilical cables from the launch site blockhouse.
2. Approximately 400 telemetry channels can be made available for data transmission in flight. Television and/or motion picture photography are also planned for experiments that require imagery, and recording facilities will be provided.
3. Instrumentation will be included in each payload to measure compartment temperatures, pressure, acoustic, vibration and longitudinal shock levels, and accelerations in coasting flight down to the  $10^{-5}$  g ( $0.1 \text{ mm/sec}^2$ ) level.

d. Available Apparatus Technology: In addition to the above supporting resources which are planned for rocket payloads, previous studies and technology development projects conducted by the Space Processing Program have defined the following capabilities that can be provided in experimental apparatus:

1. A variety of heating elements are available with low thermal inertia and operating temperatures up to  $2000^\circ\text{C}$  for heat treating experiments. However, elements for the high end of this temperature range have not yet been fully tested, and experiments requiring them will generally have longer lead times than lower temperature experiments.
2. Rapid cooling can be supplied by water or cold gas; water quench systems have already been operated successfully under weightless conditions in the MSFC drop tower and on a "piggyback" rocket flight.
3. Acoustic systems have been developed to hold levitated samples stationary in heated cavities containing gaseous media, and these systems can be used to translate samples for distances of at least several cm. A system with automatic feedback control of sample position and acoustic frequency and the ability to rotate samples is under development but has not yet been integrated with heating apparatus.

4. Technology is available to build electromagnetic systems capable of holding levitated samples of conducting materials in vacuum, heating them rapidly by induction, and rotating them.

5. Fluid and electrical systems for operation of electrophoretic separation columns have been operated on the Apollo 14 and 16 lunar missions and are being developed further for experiments on the ASTP mission. Similar systems should be suitable for support of electrokinetic experiments on the rocket flights.

#### IV. Basis for Participation

##### 1. Nature of Investigations

In general, proposals responding to this solicitation should be for projects that seek to acquire new knowledge about processes and material properties through experiments performed under weightless conditions, and/or to develop new methods of manipulating materials and processes in weightlessness. Each proposed project should aim at the attainment of some definite technical objective within two years through the performance of from one to three flights. The proposed objective or objectives may represent interim accomplishments in a long range research plan, but in this case should comprise a valid milestone of progress whose attainment would justify continuation of the project.

Proposals will be entertained for work in any field of materials science or technology, but preference will be given to projects that can contribute to materials applications on the ground or in space in accordance with the goals of the Space Processing Program. In the past, the program has conducted activities in all of the following areas:

- Electronic Materials
- Biological Preparations
- Metallurgical Processes
- Glass and Ceramics
- Physical Processes in Fluids
- Chemical Processes

##### 2. Apparatus, Instrumentation, and Ground Support Equipment

In keeping with the low cost approach outlined above, NASA wishes to implement the space processing rocket experiment program with general purpose apparatus that will be used repeatedly by multiple investigators, and to minimize requirements for special purpose apparatus specific to individual experiments.

By submitting a proposal, the investigator and his institution agree that NASA has the option to accept the offeror's plan to provide the apparatus, instrumentation or ground support equipment required for

the investigation, or NASA may furnish or obtain such apparatus, instrumentation or equipment from any other source as determined by the selecting official. The proposals received in response to this solicitation will be analyzed for commonality in their requirements and general purpose apparatus for the initial rocket flights will be defined on the basis of this analysis. In general, items of general purpose apparatus will be developed by contractors selected for their specific expertise in the relevant branches of technology, and investigators whose projects are selected will be associated with the technical direction of the development of apparatus that their projects will use.

Apparatus that is unique to individual experiments will be developed either by the Principal Investigators' organizations or by other contractors, as appears appropriate in individual cases. Since the exact definitions of general purpose facilities will not be settled until proposals are received and analyzed, definitions of apparatus unique to individual experiments will be settled by negotiation with investigators whose proposals are selected.

In order to provide for maximum flexibility in the selection of an experiment program, it is desired that proposals should be for individual projects rather than for groups of projects associated with major equipment developments. In cases where a group of investigators wishes to work with a specific equipment contractor, it is preferred that they and the contractor submit separate proposals that include descriptions of the mutual relations they envision.

#### V. Preproposal Activities

Organizations and/or individuals intending to respond to this solicitation are requested to submit brief notices of their intent to propose to the following address:

National Aeronautics and Space Administration  
Space Processing Program  
Code ESS  
Washington, DC 20546

Foreign respondents should send notices of their intent to propose directly to the above address, and also send information copies of these notices to the NASA Office of International Affairs, Code I, Washington, DC 20546. Notices of intent to propose should contain brief descriptions of the nature of the projects that will be proposed and the basic organizational arrangements the proposers envision so that NASA can make appropriate arrangements for proposal evaluation.

It is recommended that all intending participants in the Space Processing Rocket Experiment Project obtain copies of NASA Handbook (NHB) 8030.6, Guidelines for Acquisition of Experiments, which sets forth the general policies governing Announcements of Opportunity such as the present one.

NHB 8030.6 is available from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402. Orders should refer to Stock No. 3300-00574; the single copy price is 85¢, and there is a 25% discount for orders of 100 or more copies.

No preproposal briefing will be held. Persons desiring further information on the Space Processing Rocket Experiment Project or on matters relating to responses to this solicitation should contact either of the following individuals by mail or telephone:

Mr. Brian O. Montgomery  
George C. Marshall Space Flight Center  
Code PFO1S  
Marshall Space Flight Center, Alabama 35812  
Telephone: (205)453-0542

Dr. James H. Bredt  
National Aeronautics and Space Administration  
Code ESS  
Washington, DC 20546  
Telephone: (202)755-3848

## VI. Format of Proposals

Proposals submitted in response to this solicitation should contain the following material, assembled in the order given:

### A. COVER LETTER

Each proposal should be submitted under a covering letter signed by an official of the investigator's organization who is authorized to commit the organization to the proposal and its contents.

### B. TECHNICAL PROPOSAL

#### 1. Cover Page

- a. Short descriptive title for the investigation.
- b. Name of proposing organization.
- c. Names, full addresses, telephone numbers and organizational affiliations of all investigators.
- d. Date of submission.

#### 2. Summary

A concise statement of what the proposed investigation is meant to accomplish and how it will be performed.

#### 3. Background and Justification

A description of the research problem that motivates the proposal and a statement demonstrating the need for the proposed investigation.

#### 4. Objectives

A statement of what the proposed project is designed to accomplish, including a specific identification of objectives to be accomplished within the first two years of work.

#### 5. Approach

- a. Method and procedures for conducting the space experiments involved in the project.
- b. Performance criteria for success of the experiments.
- c. Apparatus and instrumentation requirements.
- d. Plans for evaluation of experimental samples and data.
- e. Supporting studies.

#### 6. Expected Results

A general discussion of the results expected from the project if successful, and their implications for the investigator's field of study.

### C. MANAGEMENT PROPOSAL

#### 1. Work Plan

- a. Program management plan and work statement, including names of the persons responsible for implementation.
- b. Names, addresses, and experience and education resumes of the project's key scientific and management personnel.
- c. Performance schedule, indicating manpower requirements and lengths of time needed to complete specific phases of the proposed project.

#### 2. Cost Plan (U.S. Proposals Only)

- a. Cost estimates for direct labor, including individual man hours and rates for the personnel involved.
- b. Estimated costs for materials.
- c. Travel costs.
- d. Overhead and general and administrative costs, with descriptions of the method of their calculation and the method for applying them to labor and other costs.

- e. Other costs (to be explained)
- f. A quarterly spending curve keyed to the work schedule.
- g. Total cost.

NASA Handbook 8030.6, Guidelines for Acquisition of Investigations, contains further general information on preparation of proposals for space experiments and should be used as a guide.

#### VII. Status of Cost Proposals (U.S. Proposals Only)

By submitting a proposal in response to this solicitation, the investigator's institution agrees that the cost plan submitted with the proposal is for proposal evaluation and selection purposes, and that after selection and during negotiations leading to a definitive contract, the institution will be required to resubmit or execute a DD Form 633 (Contract Pricing Proposal) as well as submitting all other certifications and representations required by law and regulations.

#### VIII. Disclosure of Proposal Data

The proposal submitted in response to this solicitation may contain technical data which the offeror or his subcontractor offeror(s) does not wish to be used or disclosed for any purpose other than evaluation of the proposal. The use and disclosure of any such technical data may be so restricted, provided the offeror marks the cover sheet of the proposal with the following legend, specifying the pages of the proposal which are to be restricted in accordance with the conditions of the legend:

"Technical data contained in pages ... (give page numbers) ... of this proposal shall not be used or disclosed, except for evaluation purposes, provided that if a contract is awarded to this submitter as a result of this proposal, the Government shall have the right to use or disclose this technical data to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose any technical data obtained from another source without restriction."

The Government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

#### IX. Rights in Data and Other Rights

The topics of data rights, patent rights, copyrights, protection of proprietary information, and title to experimental equipment and materials will, as appropriate, be the subject of agreement upon selection of a proposal, in accordance with NASA policies and regulations.

## X. Proposals Involving Commercial Funding

NASA is prepared to entertain proposals for projects by commercial organizations under arrangements whereby the proposing organization will pay the direct costs of the project (i.e., sample preparation, data analysis, supporting studies etc.). All such arrangements must be negotiated on an individual case basis and must adequately serve the public interest arising from the large Government investment involved in providing the facilities necessary to perform the proposed experiments in space. Agreements covering such projects will, however, include appropriate provisions concerning the rights of the parties with respect to data obtained in the project. Organizations interested in negotiating such arrangements should contact NASA as early as possible to permit timely consideration of the relevant legal and policy issues.

## XI. Receipt of Proposals

Twenty copies of the technical proposal and six copies of the management proposal should be submitted. One copy of each must be an original or a copy of high enough quality for clear reproduction.

Proposals from sources in the United States should be mailed to the following address:

National Aeronautics and Space Administration  
Space Processing Program  
Code ESS  
Washington, DC 20546

To insure consideration, experiment proposals should be received by NASA no later than January 6, 1975. Proposals received after this date will be evaluated and considered for selection on the basis described below in Section XIII, Evaluation and Selection.

## XII. Foreign Proposals

Proposals for participation by individuals outside the United States of America should be submitted in the same format (excluding cost plans) as U.S. proposals. They should be typewritten in English. Foreign proposers must have their proposals reviewed and endorsed by the appropriate foreign government agencies. Twenty copies of endorsed proposals should be forwarded before the deadline stated in the preceding section of this announcement to:

National Aeronautics and Space Administration  
Office of International Affairs  
Code I  
Washington, DC 20546  
U.S.A.



All official correspondence from foreign proposers and organizations should be directed to NASA's Office of International Affairs. Foreign proposals received by the Office of International Affairs will go through the same evaluation and selection process as U.S. originated proposals, and those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Should a proposal be selected, NASA will arrange with the sponsoring foreign agency for the proposed participation on a cooperative (no exchange of funds) basis, in which NASA and the sponsoring agency will each bear the cost of discharging its respective responsibilities.

### XIII. Evaluation and Selection

#### 1. Evaluation and Selection Criteria

Proposals received by January 6, 1975 will be evaluated and selected on an equal competitive basis by an ad hoc subcommittee of the NASA Applications Steering Committee in accordance with the procedures and criteria outlined in Chapters 4 and 5 of NHB 8030.6, Guidelines for Acquisition of Investigations. Tentative assignments of experiments to rocket flights will be made on the basis of expected development lead times, and some preference will be given to proposals for experiments that can be performed on the first three flights because full payloads for these flights must be made up from responses to the present solicitation. However, selected projects need not complete their experiment activities in the first three flights, and some projects with longer lead times will be selected as well.

The following general criteria will also be used in the evaluation and selection process:

- a. The relevance to this specific opportunity and its objectives.
- b. The scientific and technological merit of the investigation, including the desirability of the investigation within the discipline to which it pertains and the probability of acquiring positive results.
- c. The competence and experience of the investigator as an indication of his ability to carry his investigation to a successful conclusion.
- d. The adequacy of whatever apparatus and experimental method may be proposed with particular regard to their ability to supply the data needed for the investigation.
- e. The reputation and interest of the investigator's institution, especially from the viewpoint of whether the institution will provide the support necessary to insure that the investigation can be completed satisfactorily.

f. Cost, cost sharing and management will always be considered as other factors in all selections in addition to the criteria cited above.

2. Tentative Selections, Partial Selections, and Participation with Others

By submitting a proposal, the investigator and his institution agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. The investigator should also understand that NASA may desire to select only a portion of his proposed investigation, and/or that NASA may desire his participation with other investigators in a joint investigation. In the latter case the investigator will be given the opportunity to accept or decline such partial NASA acceptance or participation with other investigators prior to selection by NASA. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its leader or contact point.


3. Late Proposals

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, but before award is made, should such action be in the interest of the Government.

In general, proposals received after January 6, 1975, will be considered for selection under the present solicitation if additional experiments are needed to fill the first three flights. Otherwise, late proposals will be deemed responsive to the next Announcement of Opportunity for the Space Processing Rocket Experiment Project and evaluated with proposals responding to it if the proposer so desires.

XIV. Next Announcement of Opportunity

It is anticipated that a new Announcement of Opportunity will be issued for the Space Processing Rocket Experiment Project in the spring of 1975, and that revised announcements will be issued annually thereafter over the life of the project.

  
Charles W. Mathews  
Associate Administrator  
for Applications

NOTICE

Effective with this Announcement a new system of numbering NASA Announcement of Opportunity documents will be used by the Office of Applications and the Office of Space Science. Examples of the numbering format for Announcements follows:

For the Office of Applications  
OA-74-1

For the Office of Space Science  
OSS-74-1

Note that the letters are an acronym for the program office, the middle digits stand for the calendar year of issue, and the final digit is the serialized sequence of the announcement within the year indicated.

For further information regarding the changes in format write to:

NASA Headquarters  
Office of Applications  
Applications Steering Committee  
Secretariat  
Code E  
Washington, DC 20546

or

NASA Headquarters  
Office of Space Science  
Space Science Steering Committee  
Secretariat  
Code SS  
Washington, DC 20546



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON, D.C. 20546



REPLY TO  
ATTN OF: ESS

December 11, 1974

MEMORANDUM

TO: Recipients of the NASA Announcement of Opportunity, OA-74-1,  
Dated November 8, 1974, Entitled "Space Processing Rocket  
Experiment Project"

FROM: E/Associate Administrator for Applications

SUBJECT: Changes to the Announcement of Opportunity, OA-74-1

1. The last paragraph of Section XI, Receipt of Proposals, of the above Announcement is revised to read as follows:

"To insure consideration, experiment proposals should be received by NASA no later than February 3, 1975. Proposals received after this date will be handled as indicated in Section XIII, 3, Late Proposals."

PLEASE NOTE THAT THIS EXTENDS THE PROPOSAL DUE DATE FROM  
JANUARY 6, 1975, TO FEBRUARY 3, 1975.

2. The second (last) paragraph of Section XIII, 3, is deleted.
3. Questions on these changes or on matters relating to the referenced Announcement of Opportunity should be referred to either of the following individuals by mail or telephone:

Mr. Brian O. Montgomery  
George C. Marshall Space Flight Center  
Code PFO1S  
Marshall Space Flight Center, Alabama 35812  
Telephone: (205)453-0542

Dr. James H. Bredt  
National Aeronautics and Space Administration  
Code ESS  
Washington, DC 20546  
Telephone: (202)755-3848

  
Charles W. Mathews